THE JOURNAL
of the AMERICAN DENTAL ASSOCIATION

Vol. 15 OCTOBER, 1928 No. 10

Original Communications

PRESIDENT'S ADDRESS*

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AT the time of adjourment of the Sixty-Ninth Session of this Association in Detroit last October, two facts were evident to the Officers, Board, Commissions and Committees of this administration: first, they were burdened with the duty and responsibility of reorganizing the general office of the Association and, second, there were only ten months, five-sixths of the usual time, in which to prepare for this meeting. Just how earnestly they assumed that obligation and how efficiently they have discharged their duties, you shall be the judge, when you shall have heard and studied their reports and shall have, we hope, enjoyed and profited from their programs.

REORGANIZATION

The task of reorganizing the general office naturally fell to the Officers and the Board of Trustees. It has been no small task and has required a great deal of their time and an enormous amount of thought in the laying of plans and the execution thereof.

In order to make possible maximum efficiency in the office procedures, to outline and to delegate definite authority to the members of the staff, to provide a plan of organization that can be easily expanded that it may care for increasing duties and additional lines of work, the activities now carried on by the general office have been divided into three departments; namely, the Secretary's Department, the Editor's Department and the Business Manager's Department. In the Secretary's Department, three bureaus have been established. Each is for the purpose of handling a specific type of work. The names of these bureaus will explain the function of each: first, the Dental Health Education Bureau; second, the Library Bureau, and third, the Chemical Investigation Bureau. In this and in the other departments, other bureaus may be set up to handle definite

*Read before the First General Meeting of the Seventieth Session of the American Dental Association, Minneapolis, Minn., Aug. 21, 1928.

lines of work that logically belong to the respective departments as, in the interest of efficiency and good business, the desirability and expediency may arise.

The activities of the general office rather naturally group themselves into these three divisions. The Charter and By-Laws outline and definitely place certain of them. The divisions are bounded as follows. The Secretary is the elected representative of the Association in the general office, and his department will therefore handle all affairs that have to do directly with professional contacts and the general policy of the Association toward the public.

The Editor's Department has been definitely placed in charge of and made responsible for the choice and preparation of the literary content of THE JOURNAL.

The Business Manager is engaged by and accountable to the Board of Trustees, who, in turn, are accountable to the House of Delegates. In this department has been placed all the affairs of the Association that are primarily of a business nature. The employment of a trained business executive to handle the business of the Association is an innovation which, we feel, has already justified itself. The Association is operating on a budget system, strictly, and, therefore, the authority of the business manager as far as expenditures is concerned is exactly defined. However, he has been given plenty of authority to exercise his business training and acumen for the general benefit and material profit of the Association.

The head of each of these departments is directly and entirely responsible for the conduct and efficiency of his department. While the field of each department is defined, at certain points they touch, though do not overlap each other. In the present scheme, these interdepartment contacts are so well guarded by the budget limits and by resolutions of the Board of Trustees that it seems unlikely that any friction will ever develop if there is a reasonable amount of cooperative spirit displayed by the department heads.

Proper authorization of expenditures under the budget; careful checking and scrutinizing of bills and accounts; monthly, quarterly, and annual reports and audits; counter signature of checks; and surety bonds carried on those responsible for funds are the principal precautions that have been taken to protect the Association's interests, all of which are merely usages of good business which the heads of departments have themselves suggested and welcomed.

A careful study of the reports that will be made to the House of Delegates by the officers, heads of departments and auditors will disclose the fact that the Association's affairs are in a healthy condition and have been carried on expeditiously and to the benefit and profit of the Association in every way. While it is true that the ingenuity, initiative and devotion to the task at hand shown by the departmental heads accounts for much of the progress and accomplishment during the past year, the plan of organization has made it possible for these departments to function with increased effectiveness. Cooperation and harmony between the departments in advancing the best interests of the Association have prevailed.

RESEARCH

Research has been the principal means of developing dentistry from the position of a specialized trade to that of a recognized profession. It is now apparent that, in order to maintain and develop in importance and effectiveness as an indis-

pensable health service factor, dentistry must prosecute and be guided by extensive and exhaustive researches. These researches must not be confined alone to the problems of mechanical and restorative dentistry, but must include the investigation of problems in the fields of the related basal sciences. It is also true that before research findings can be unqualifiedly accepted for the guidance of practice, they must withstand the acid test of practical application. In carrying out this test, the profession must use reasonable caution, keen discrimination and the utmost honesty lest it be rightfully accused of following fads, and eventually be greatly discredited. At the present time, the dental profession is accepting in increasing numbers these assertions concerning research as substantially true.

Throughout the history of organized dentistry, much experimentation and, here and there, some very valuable research had been done, but the profession's interest in research and research results grew very slowly. It is only in very recent years that the value of research has been realized by any considerable number of the profession. Time will not permit a discussion of many of the interesting lesser factors that have been active in overcoming the profession's inertia in this matter. In 1913, only fifteen years ago, the American Dental Association authorized the formation of the "Scientific Foundation and Research Commission," which step represented the first expression of organized dentistry "to support, establish and encourage research." The Research Commission and its activities have done more to stimulate interest in research and research results than any other one agency. There was need of some such organization or activity to stir and then to crystallize that interest, and the Commission has served and is still serving that purpose as one of its functions. It is readily observed that interest in research in all its phases is growing among the members of the profession.

As is usual in all pioneer movements, several plans have been devised and used from time to time by the Commission in an effort to fulfil its mission, but, for the last nine years, the Commission has followed the policy of encouraging and assisting rather than establishing and wholly supporting research projects. By this plan of giving assistance in the form of a grant, meritorious researches have been encouraged, extended and intensified, and researchers of known ability have been able to initiate new investigations, so that, by and with the help of the American Dental Association's Research Commission, research activities in the interest of dentistry have been measurably increased. All the recipients of grants are now carrying on their investigations in colleges, hospitals or other institutions offering suitable opportunities and facilities for conducting worth while researches. Obviously, this plan has many advantages.

During the past year, thirteen projects have been assisted by grants. For the most part, the problems under investigation deal with pathology, bacteriology, biochemistry, nutrition, etc.; in other words, they are largely biologic in aspect. For several years, however, the Research Commission has been negotiating with the National Bureau of Standards at Washington, D. C., concerning a possible affiliation whereby researches of a physical and chemical nature might be conducted, exclusively for the American Dental Association, on dental materials such as golds, alloys, solders, fillings, impression and investment materials and vulcanites. Since 1924, the Commission has carried a tentative appropriation in

its budget to be used in this work whenever conditions satisfactory to both the Bureau and the Commission should appear. It is gratifying to be able to announce that, during this past year, this affiliation has been consummated. Although the final plans for carrying on all the work incident to this extensive investigation are not at present completed, preliminary work in the Bureau is under way, in charge of a competent Research Associate approved by the Director of the Bureau and selected and employed by the Research Commission.

For a number of years, there has been a growing conviction in the minds of the profession that a thorough investigation and careful checking of the actual content and advertised value of drugs, proprietary prescriptions and preparations, offered for the cure and alleviation of diseased oral and systemic conditions to the profession and to the laity under various trade names, should be carried on by this Association. A possible plan for the carrying on of some type of research of this sort has been under investigation by a special committee, appointed at the Sixty-seventh Session of the American Dental Association in Louisville, and renewed at the Sixty-eighth meeting in Philadelphia. However, nothing very definite had been accomplished until during the last administration, when most of the negotiations and preliminary arrangements were made whereby this Association was granted the privilege of installing in the Laboratories of the American Medical Association a graduate chemist whose duties should be to investigate the classes of medicaments just mentioned. This plan was completed by the selection and installation of such a chemist during this administration. The American Medical Association for several years has carried on a vigorous investigation of a similar class of medicaments offered to the laity and to the medical profession. The dental profession is fortunate in being able to share in and profit by the medical association's rich experience in this line of endeavor. It is certain that the dental profession will appreciate this spirit of cooperation and courtesy on the part of her sister organization.

The affiliation with the Bureau of Standards and the installation of a chemist in the American Medical Association Laboratories give promise of producing information that will have immediate application in the so-called practical phases of dentistry. Aside from the immediate practical benefit that will accrue to the profession and, through it, to the public, the accumulative effect of these investigations will be a strong factor in standardizing, systematizing and establishing the practice of dentistry on a proved scientific basis.

STATE SOCIETY OFFICERS' CONFERENCE

In January of this year, the second "State Society Officers Conference" was held in Chicago. To these conferences, the Officers and Trustees of this Association have invited the president and the secretary of each component society. Any other interested members of the Association are welcome. The purpose of these conferences is to provide an opportunity for the presentation and discussion of organization affairs and problems. The program at our January conference consisted of papers and discussion on several interesting and timely subjects. Many valuable and practical suggestions, plans and ideas were brought out both in the prepared papers and in the informal discussions. The growing interest in these conferences was evidenced by a substantial increase in the attendance over that of last year. Twenty-seven states were

represented by thirty-eight presidents and secretaries. These conferences have been of value not only to the officers of the state societies but also to the Officers and Trustees of the parent body, in giving them an opportunity to become familiar with the problems and activities of the component societies. These problems and activities are reflected in the parent organization, and therefore the Officers and Trustees are interested.

BULLETINS

In order to record permanently and compactly the deliberations of this gathering and to make them immediately available to the state society officers who were unable to attend and to the general membership, a pamphlet containing a complete record of the conference was compiled and printed. It has been designated as Bulletin No. I, and is entitled "Conference of State Society Officers." It is very evident from the commendatory expressions heard on every hand that this bulletin has been very warmly received not only by officers and committeemen but also by the membership in general and is serving a very useful purpose in providing ideas and inspiration for carrying on organization activities.

While the bulletin plan of permanently recording and immediately disseminating information among Association members is an innovation among the publications of the American Dental Association, it is believed that its use will increase when its evident advantages are considered and other occasions appear to justify its use.

A second bulletin was issued this year. It is entitled "Events Program" and carries information concerning the meetings and programs of affiliated groups, fraternity functions, sports events, social activities, hotel, railroad and touring information, a skeleton of the official program, registration notices and instruction, and many other items related to this Seventieth Session which were considered to be of interest to the membership in planning their attendance on this meeting. It was also hoped that this bulletin would inspire interest in the general Association and stimulate attendance at this meeting.

RELIEF

During the past fiscal year, the Relief Fund has increased to more than $200,000. It is safely invested in securities which earned more than $10,000 last year. The principal of this fund is zealously guarded and is being increased by the net income from the sale of Christmas seals, contributions and legacies and the residue of the earnings, after the expenditures for actual relief have been deducted. All expenses of administering relief are paid out of the general fund of the Association. The relief is dispensed through the Relief Commission. A small fund is always at their command in order to give immediate assistance in cases that are of an emergency nature, and in which the noble purpose of this fund would be defeated if time were taken to follow the usual routine. Many sad and touching conditions have been revealed to this Commission and have been relieved by this humanitarian fund. Kindly interest and genuine sympathy not inconsistent with a sane administration have invariably been exhibited by the Commission in carrying out its functions.

Some state societies which operate on a budget system and have had occasion to dispense relief to needy members have allocated funds or, by a division of the dues, are creating funds for the purpose of meeting the requirement made of component societies when applying to the national Commission for relief for one of their number. Some have even created state relief commissions and committees

and clothed them with authority to act. The advantages of thus organizing and systematizing this relief activity are obvious. This plan, or another that meets local conditions yet complies with the Association's requirement, is rapidly gaining favor and is being seriously considered for adoption by many societies.

Up to the present time, the expenditures for relief have never equaled the earnings from the invested fund. However, as this movement among state societies develops, and, as a consequence, interest in and sympathy with carefully administered relief grows, it is reasonable to suppose that increasingly greater demands will be made on the national funds. From the point of view of the membership and in the interest of good business, it seems highly desirable and entirely possible to increase the principal of the relief fund so rapidly that its earnings will meet this probable increasing demand for years to come. Both modest and sizable contributions and bequests to this fund have been made and are acceptable. Such gifts undoubtedly afford satisfaction and pleasure to the giver in that he can feel that he is contributing to a worthy cause. Through the sale of Christmas seals, there is provided a method whereby every member of the Association may feel that he has a part in this worthy undertaking. It has been customary to send these seals to every member of the Association. Some have remitted more than one dollar for them, but the large percentage of remittances have been for the smaller amount. Some dental supply companies and manufacturers, without publicity, have purchased seals in large quantities or have contributed directly to the fund. However, the total sum collected each year, even including the larger contributions, has not equaled one dollar per member for 50 per cent of the Association's yearly membership. Surely the giving of one dollar for Christmas seals cannot be considered a sacrifice or a hardship to any member of this Association. Undoubtedly, many members have been unintentionally careless in the matter of remitting. Some may hesitate because they do not know how carefully the contributions and funds are handled. But in this regard all members may rest assured that the custodianship of these funds and the dispensing of relief under them are considered in the nature of a sacred trust by the Officers of the Association, the Board of Trustees and the Relief Commission. Every precaution is taken to keep the funds properly credited with all contributions and safely intact.

Members of the Association who have not regularly contributed may not know that actual relief is being dispensed and therefore see no reason for creating this fund. Others may not personally know of specific instances where relief is needed or has been given and, therefore, may not realize that there is a growing and urgent need for this charitable service. But consideration for the feelings of the recipients forbids the publication of their names. Furthermore, it is believed that publicity and ostentation have no place in the Association's plan of giving.

The Relief Committee, the general Officers and many particularly interested members have done yoeman service in building this fund and providing for its administration. Plans for a Christmas seal with a new design and for a concerted effort in the interest of relief throughout the component societies are now being enthusiastically worked out by the committee. But the committee must have the whole-hearted, active support and cooperation of the membership if the results are to be commensurate

with the worthiness of the cause. It is hoped that each member present will voluntarily constitute himself an active exponent of this movement and, by expression and deed, lend continuous support to this benevolent plan.

Many other achievements, developments and activities of this wonderful organization might be discussed here with profit and satisfaction, but the constitutional time limit for the address, I fear, is being rapidly reached. However, in closing, I wish to commend to you the program which has been prepared for your pleasure and profit during this meeting. It comprehends practically every phase of modern dentistry. It is outstanding in the number contributing and in the known ability of the participants to present the subjects that they have selected. I am confident that the membership will appreciate the worth of these contributions and be thankful to these men for their willingness to give of their time and their skill for the benefit of us all. The general office and its staff, the officers of sections, the chairman of clinics, the exhibit committees and all other special committees that have been charged with the actual building of this program are to be commended and congratulated. All in all, it has been no small task to accomplish in ten short months.

The Association is particularly fortunate in having at its disposal the wonderful facilities for staging this meeting provided by Minneapolis. But the Association is still more beholden to the local committee and to the profession of Minneapolis, of Minnesota and of the Seventh District for their whole-hearted and enthusiastic share in planning and staging this meeting. The Local Committee and its organization have devoted unstinted thought and unlimited labor that all the arrangements and details might work out to the maximum pleasure and profit of all. Throughout the entire year, they and the profession of Minneapolis have shown their desire to be our gracious and willing hosts in every sense of the word. No task has been too great, no detail too small to receive whole-hearted attention if our comfort, our pleasure or our professional profit might thereby be increased. Many innovations in the general plans and details of organizing and staging this meeting have been instituted. It is hoped that they will prove of value. We owe the Local Committee and its entire organization our thanks for loyal, enthusiastic and efficient service.

As President, it has been my pleasure and inspiration to work with all the Officers, the general office staff, the committees and committeemen. Their loyalty to the best interests of the profession and their energetic unselfish service in the performance of their duties have been potent factors in the accomplishments of the year. Their helpful suggestions and cooperation have been of inestimable value to me in discharging my duties as President. I wish also to acknowledge many pleasant contacts with and helpful suggestions from the profession at large, who, in the final analysis, are the principal concern and the primary source of inspiration of this organization. To all those who have assisted in carrying on the activities of this Association, who have participated in its councils and administration, and who have, in any way, been accountable for the preparation and presentation of this Seventieth Session, the crowning event of my administration, I wish to record my sincere appreciation for their interest and service and to express my gratitude for their loyalty and assistance.

The honor of serving as your President, the highest office in the gift of organized dentistry, is a notable one, which I assure you I appreciate. The past year has been the most strenuous year of my life. During this year of developing a new type of administration of your business, there has been no time for Sunday morning naps. The Rock Island sleeper has carried one passenger from Iowa City to Chicago most Saturday nights and back again on Sunday or Monday night. The willing workers at the American Dental Association headquarters have sacrificed many a well-earned Sabbath holiday to accommodate their chief, whose anxiety to hand over to his successor a well-oiled and smooth-running machine made of him a somewhat merciless driver. If, however, our service wins your approval we shall all feel well-paid.

Not all the year has been only hard work. New and old friendships have grown closer. Already the vexing problems are fading from memory, and it is with a real sense of regret as well as with pride that I shall, in another three days, hand over to my beloved successor the gavel, badge of the highest authority which I have ever enjoyed, and the highest honor to which any dentist may aspire.

STUDIES IN PALEODONTOLOGY. I. MATERIALS FOR A STUDY OF PREHISTORIC DENTISTRY IN PERU*

By ROY L. MOODIE, Ph.D., Los Angeles, Calif.

INTRODUCTION

AIDED by grants from the Research Commission and the College of Dentistry, University of Southern California, I shall now be able to develop that phase of paleopathology which I have chosen to call prehistoric dentistry. As the first paper of the series of studies which will be required to elucidate the various problems connected with this subject, I shall give a résumé of the entire field of work, as it appears to me now, giving the position of this study in the field of general medical and dental history, and showing its relation to the archeology and culture phases of the pre-Columbian inhabitants of Peru.

Accompanying this will be given an account of the collection of pre-Columbian, Peruvian, pathologic and injured craniums now preserved in the San Diego Museum of Anthropology at Balboa Park, and the studies, already published, which have been based on that assemblage. A survey of the available collections in the United States, in Europe and in Peru will likewise be given. The relation of environment, food and food habits, the climatic changes due to orogenic movements on the organs of the mouth will be briefly referred to and commented on.

The quality of the material preserved for study will have an important bearing on the results obtained, and for that reason I shall devote a little time to the con-

*Work done under grants from the Research Commission of the American Dental Association and the University of Southern California, College of Dentistry.

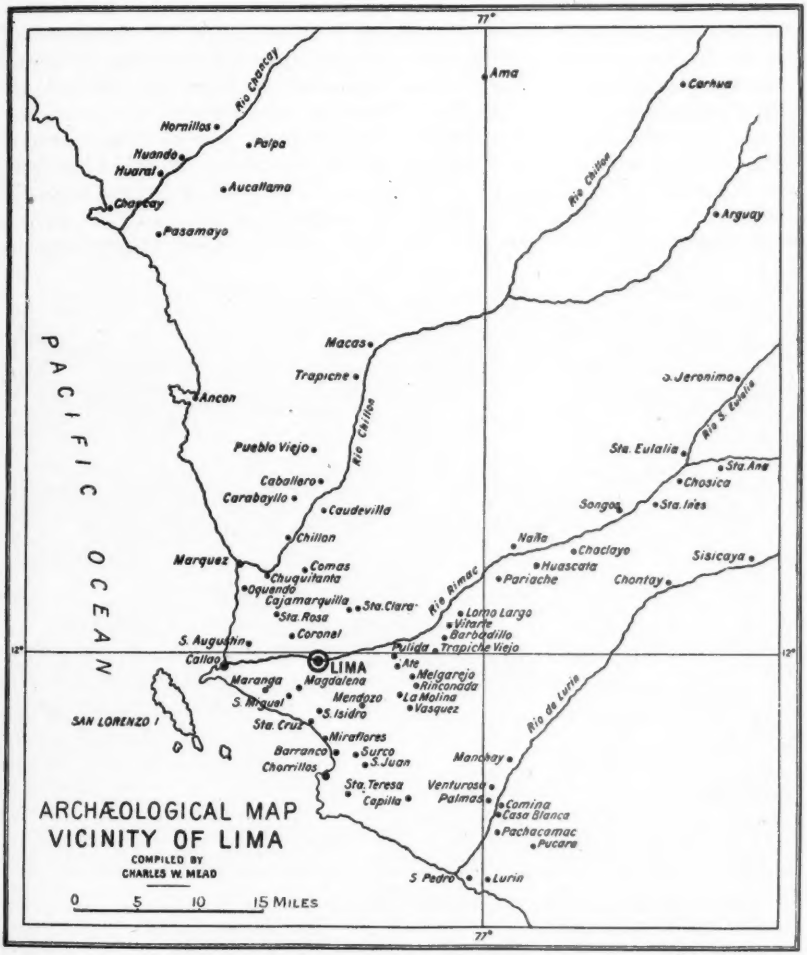

Fig. 1.—A sketch map of the vicinity of Lima, Peru, showing the location of numerous prehistoric settlements near which the prehistoric cemeteries are found. It is especially noteworthy to observe how these ancient dwelling places are arranged along the river valleys; the one exception being Ancon, of which more later. There are about fifty of these coastal valleys, at the present time largely desert, but in ancient times highly cultivated and irrigated. One of these valleys is shown at *B*, Figure 5. Desert lands extend for more than 2,000 miles along the western coast of South America. In this strip of desert, nowhere more than 150 miles wide, are hundreds of prehistoric cemeteries, containing thousands of graves, covering a period of more than twenty centuries. Most of these have been exploited by treasure hunters, who for centuries have left behind them a welter of ruin as shown in Figure 2. Occasional floods from the highlands, rushing through the valleys, open and destroy hundreds of graves, leaving the skeletons projecting from the banks. Some of the valleys are being reopened to irrigation and cultivation by modern capital; which will further destroy these relics of antiquity. The author's studies are based on the mummies and skeletons recovered from these cemeteries and elsewhere. Prehistoric dentistry must be founded on what material is left. **(Map after Mead.)**

ditions under which the material for study was preserved and collected. This involves a survey of many things which, at first glance, have little or no relation to the subject of prehistoric dentistry. It is not possible now, however, to understand the conditions of the mouth regions without an understanding of the environment under which the people lived. Their food, their homes, their accidents and diseases all aid in an understanding of our problem.

As side lines of thought and investigation, I shall develop from time to time the details of lesions of the mouth of the pleistocene mammals, particularly those from the Rancho la Brea, southern California. The details of oral lesions of recent mammals are also deemed a part of the field of work, for, from a broad point of view, disease is the same wherever we see it. The ray fungus produces actinomycosis in man as well as in mammals. We are led to regard disease as an expression of the results of antagonistic forces, and not as something acquired by accident. Thus, a detailed study of an acute osteomyelitis in one of the raccoon family, a coati, shows the lesions to have been exactly the same as those seen in man. Not only is this interesting, but it also fills one of the great-

Fig. 2.—Prehistoric graves in one of the coastal valleys of Peru, opened by peons in a hunt for treasure, which consists of gold and silver ornaments, jewels and pottery which were interred with the dead. The mummies or their skeletons, their wrappings and the less salable pottery are all dumped on the edge of the grave, to be destroyed by the weather. The material in the San Diego Museum was obtained from such places as are shown here, as well as from burial places of a different type in the highlands. (After Hrdlicka.)

est needs felt in the pursuit of the study of paleopathology, and that is, adequate modern examples of disease with which to compare the ancient expressions.

The value of the geography of disease in its application to paleopathologic studies has not been appreciated. When we find, for instance, the evidences of *goundou* indicated in ancient Peru, and existing today in Melanasia and West Africa, the thought at once occurs: Will a study of the distribution of disease lead us to understand the origin of the people who first inhabited Peru or the migrations of later people who overcame the first inhabitants? A detailed distribution of the evidences of oral diseases will ultimately be clotted, as a result of the studies outlined here, and will be combined with the consideration of discases of other parts of the body.

PREHISTORY OF PERU

The prehistory of the Peruvian area is one of fascinating interest. In this region, people of diverse cultures have lived for thousands of years. Dynasties grew and waned centuries before recorded history, and it is the task of the prehistorian to puzzle out, from the ma-

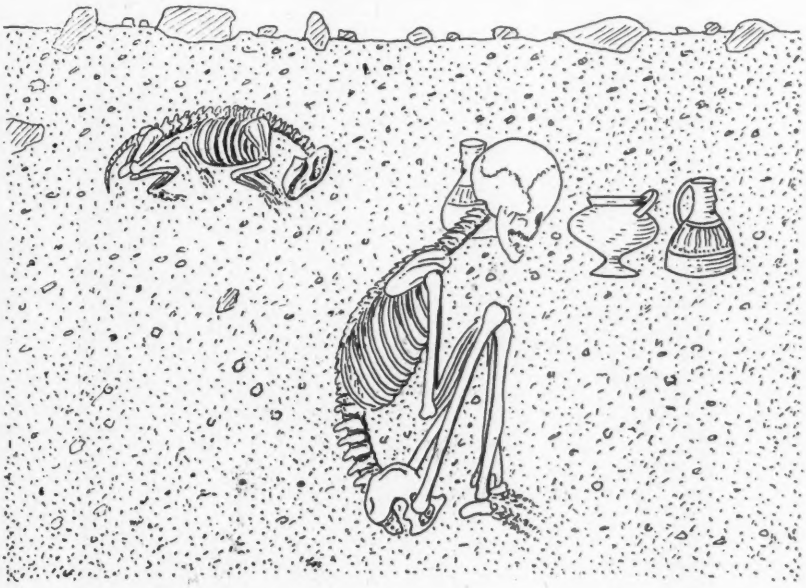

Fig. 3.—A section of a burial in the highlands near Machu Picchu, Peru, showing a common type of burial without wrappings. The body is in the sitting position, found alike along the coast and in the mountains. The three pieces of pottery near the body show the burial to have been of the Inca Period, which closed with the coming of the Spaniards in 1530. The dog to the left is a variety of *Canis ingae*. This species had been under domestication for a period long enough to have developed a number of varieties, probably during several hundred years. The domestic dog may possibly be regarded as one source of food for the ancient people. (After Eaton.)

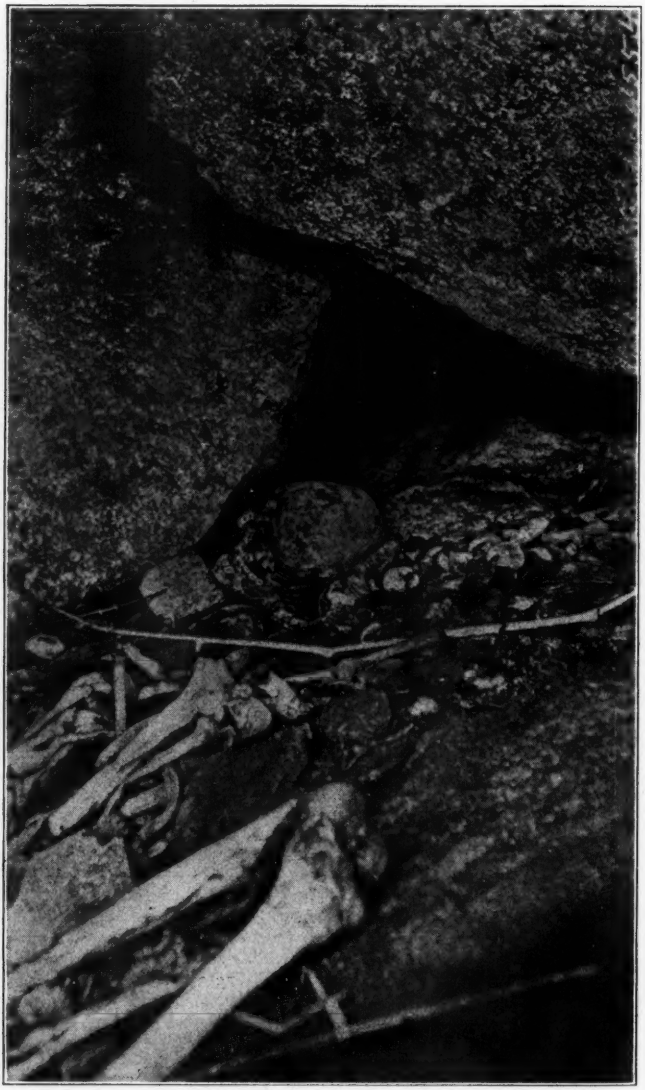

Fig. 4.—A common method of burial in a small cave or rock shelter in the mountains near Machu Picchu, Peru. The skull and mandible are associated, but the premaxillary is missing. Other bones are broken, scattered and lost. The knee in the foreground indicates that the body was buried in a sitting position. The scattered rocks belong to the loose wall built around the body. (After Eaton.)

terial at hand, the details of the daily life of these ancient and interesting people.

Some of their ruins are notable. The massive-walled buildings and fortresses in the mountains have been many times described. An ancient city called Chan-Chan,[1] meaning Sun-Sun, is said to have covered an area of about 11 square miles. Located on the desert plain near the coast, this city is thought to have had at one time a population of nearly a million people, at which time, of course, the whole area was irrigated and under cultivation. The city was defended by a wall in places 60 feet high, like Babylon. The adobe walls and houses have for centuries been reduced to mounds of earth. Although the coastal area, in which the ruins lie, is largely a rainless desert,[2] the occasional downpours wreak untold havoc. Within these ancient walls were built several huge, Egyptian-like pyramids, of sun-baked mud, which were used for worship of the sun, for dwelling places and for burials. Most of these temples have been desecrated and largely destroyed by treasure hunters. One temple alone is said to have yielded some $11,000,000 in gold and silver. It is no wonder that the common people, the peons, resort to the ancient graves for gain.[3] Mummies, wrapped and unwrapped, bones, pottery, are all thrown carelessly around the edges of the excavations (Fig. 2), or broken and destroyed in a search for valuables. As in Egypt,[4] this desecration of treasure hunters has been going on for centuries.

In the highlands[5] lived and worked the premegalithic, the megalithic and the Inca-ruled peoples. Many of these excelled in masonry, and they built huge temples, walls and houses of the finest cut stone, with contact surfaces fitted so nicely that no mortar was used to hold them in place, yet after centuries the joint surfaces are so close that a knife blade cannot be inserted. A modern railroad company, needing stone for filling a road bed across a swamp, removed hundreds of train-loads of these ancient edifices to make a firm roadway for their steel rails.

Through all this welter of wreck, ruin and desolation, the archeologist, the anthropologist and the paleopathologist must find his way as best he can. The prehistorian must reconstruct such evidences as remain and on these build his knowledge of past events.

Wallis Budge[6] has estimated that of the 800,000,000 who died in Egypt during the periods when embalming was in vogue, probably less than 100,000 bodies were carefully prepared. The remainder were thrown into the river Nile for the crocodiles, left in the desert for the jackals or buried in shallow pits. Mummies were expensive, and the proudly rich spent untold fortunes that their bodies might be ready for the resurrection and life eternal with Osiris. I believe also that relatively few of the ancient Peruvians were mummified. Possibly they belonged to the leisure class

1. Holstein, Otto: Chan-Chan: Capital of the Great Chimu, Geographical Rev., 17: 36-61, 1927.

2. Bowman, Isaiah: The Andes of Southern Peru, 1916.

3. Hrdlicka, Ales: Anthropological Work in Peru in 1913, with Notes on the Pathology of the Ancient Peruvians, Smithsonian Miscellaneous Collection, 61:1-69, 1914.

4. Smith, G. E., and Dawson, W. R.: Egyptian Mummies, pp. 1-190, 1924.

5. Kroeber, A. L.: Coast and Highland in Prehistoric Peru, Am. Anthropol., 29:625-653, 1927.

6. Budge, E. A. W.: The Mummy. A Handbook of Egyptian Funerary Archeology, 1925.

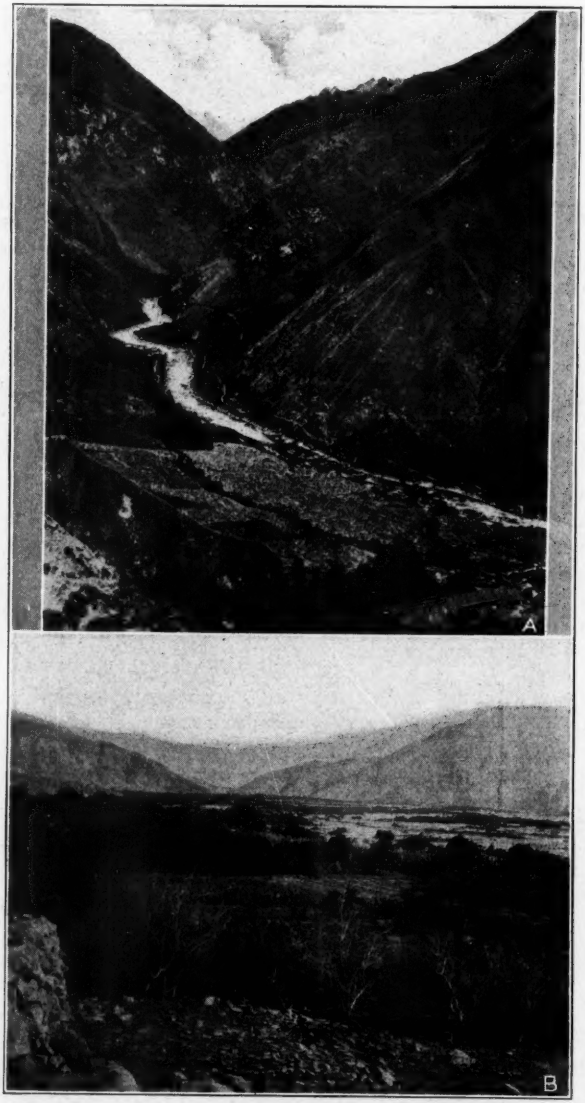

Fig 5.—Coastal valley and the highlands in Peru; a study in contrasts. *A:* The mountains of Peru from ice to sugar cane, Uruhamba Valley, at Colpani, on the northeastern border of the Cordillera Vilcapampa, looking upstream. In the extreme background, and near the top of the picture, is the sharp peak of Salcantay. Only the lower end of the more open portion of the Canyon of Torontoy is here shown. There is a field of sugar cane in the foreground, and the valley trail is shown on the opposite side of the river. (From "Andes of Southern Peru," by Bowman.) *B:* One of the coastal valleys of Peru. (Photograph by Isaiah Bowman.)

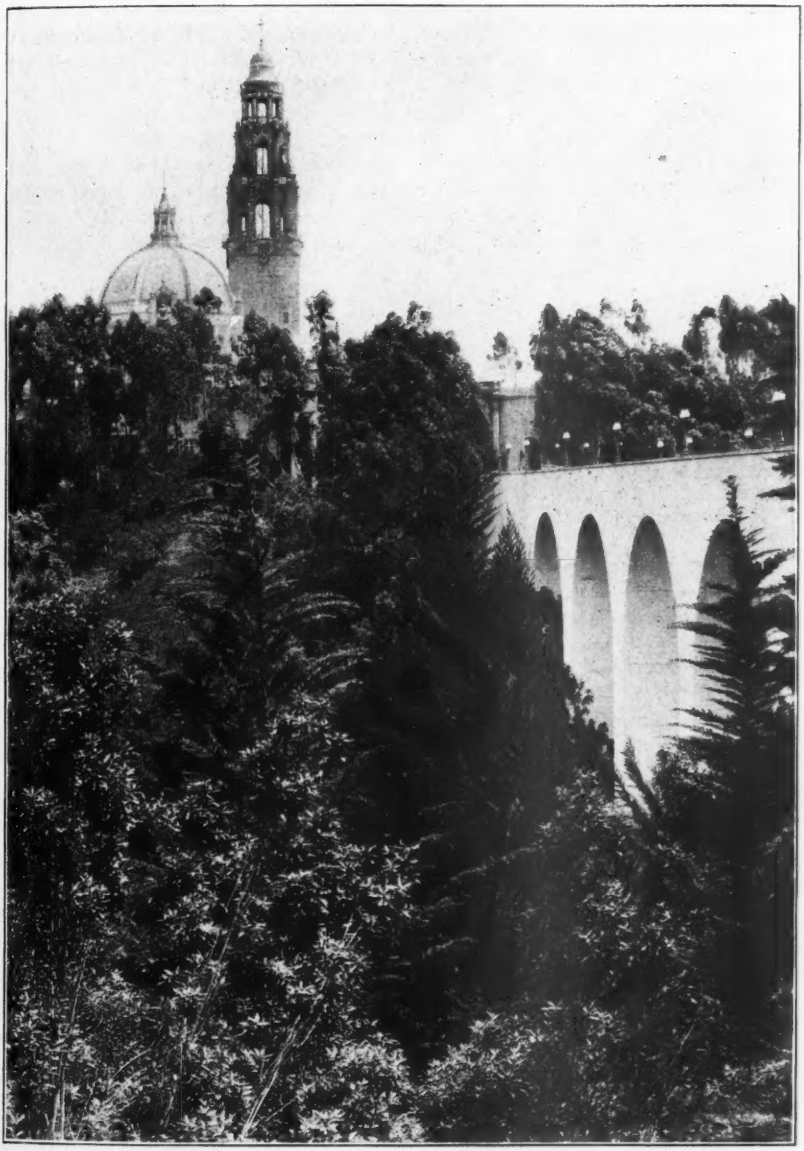

Fig. 6.—After centuries in the hot desert sand, in dreary rock shelters and caves in the mountains, some of the pre-Columbian Peruvians find a resting place in the San Diego Museum of Anthropology at Balboa Park. To the right between the trees above the Cabrillo Bridge is the building which houses the Hrdlicka collection of prehistoric materials from Peru on which is to be initiated the study of prehistoric dentistry.

of early times. The mummies preserved in the museums of the world may be reckoned by a few hundred. Those destroyed by the weather and by treasure hunters by a few thousands, and an untold number remain buried. It is now illegal to excavate for treasure, but excavation goes on just the same, and we must make our study of prehistoric dentistry while material yet remains.

ferent climatic conditions. The oral conditions were affected by the differences in food in the different areas, by the contact of different races and the effects of different environments. MacCurdy[7] and Eaton[8] have discussed the physical anthropology of the mountain people, and have written about all we know of the conditions of the mouth in ancient times. Hrdlicka[3] has discussed in a most

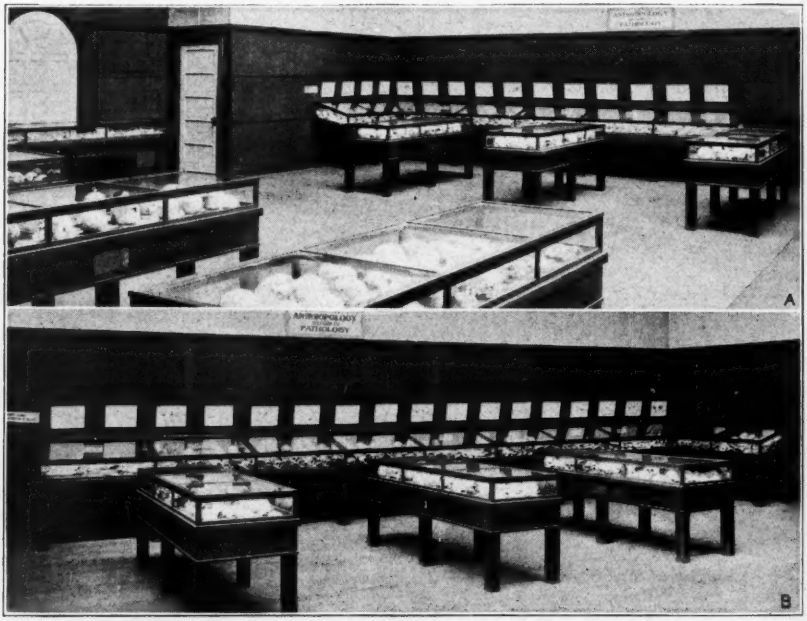

Fig. 7.—The Hrdlicka collection of pre-Columbian skeletal material from Peru, as exhibited at the Panama-Pacific Exposition in San Diego in 1915. The collection was later moved to a fireproof building across the street.

THE COASTAL DESERTS AND THE HIGHLANDS

It is important to recognize the division of the Peruvian area into the coast and the highlands. Kroeber[5] has pointed out the influence of these regions and the modification of culture by the different climatic conditions. The oral conditions were affected by the differences in food in the different areas, by the contact of different races and the effects of different environments. MacCurdy[7] and Eaton[8] have discussed the physical anthropology of the mountain people, and have written about all we know of the conditions of the mouth in ancient times. Hrdlicka[3] has discussed in a most interesting way the manner of occurrence of the human remains of both coast

7. MacCurdy, G. G.: Human Skeletal Remains from the Highlands of Peru, Am. J. Physical Anthrop., 6:217-329, 1923.

8. Eaton, G. F.: The Collection of Osteological Material from Machu Picchu, Memoirs Conn. Acad. Arts & Sc., 5:1-96, 1916.

Fig. 8.—Mummy of a child, age to be determined later from roentgenograms (natural mummification); from Lupo, near Huarochiri, Peru, in original wrappings. (No. 1149, San Diego Museum of Anthropology at Balboa Park.) Infant mortality was high in pre-Columbian Peru, if judged from the great number of baby mummies. The greatest collection of infant mummies is in the Field Museum, and the dentition is now being studied from the roentgenograms. The wrapping of coarse cloth, bound with fiber rope, of native manufacture, has rotted, allowing the bones to leak out at the bottom. Pre-Columbian infants seem to have suffered very little from bone diseases or dental disturbances. Death was doubtless due to improper diet or febrile conditions. This picture, with Figures 9-11, shows the different ages of the pre-Columbian bodies available for a study of prehistoric dentistry.

and mountain. Reiss and Stübel[9] have written a marvelous account of the Necropolis of Ancon, on the ocean edge. It seems likely that this particular spot has been inhabited constantly for more than 2,000 years, and a modern town of Ancon still thrives.

The ancient Peruvians did not permit our modern political boundaries to limit their activities, and when we speak of the Peruvian area of ancient times, something other than the Peru of today is indicated. Under the Inca princes, especially, the people extended their empire in many directions. Mead[10] has discussed this matter thoroughly, and those interested may read his delightful volume or refer to my discussion.[11] In Peru today, Tello,[12] himself a highlander by birth, is doing more than anyone else to bring order out of the confused archeology. The museum and university at Lima are preserving his records, and he is aided in his interpretations by Kroeber, at the University of California, and at the Field Museum of Natural History. Scientific work in Peru today is largely centralized in Lima, and the leader in prehistory is Julio C. Tello.

PREHISTORIC CEMETERIES AND OTHER BURIAL PLACES IN PERU

The sources of ancient materials from Peru are, on the coast, the hundreds of ancient cemeteries which occur throughout the 2,000 miles of desert, extending into the Atacama itself.[8] All the collector has to do is to visit the excavations made by treasure hunters, and select what material appeals to him. This is not, however, conducive to the highest scientific results. Excavations made under the supervision of experienced archeologists who note the conditions surrounding the human remains will yield much better results. The San Diego collection was made under the first of these conditions, and Kroeber, working for the Field Museum, with the aid of Tello, in Peru, has operated according to the latter plan. Kroeber and his associates, at the University of California, have issued a volume of studies on material collected in a scientific manner by Max Uhle.

In the highlands, resort must be had to a search for caves, rock shelters and infrequent burial places. The prevalence of rock prohibits grave interment in the mountains, and the ancient Peruvians did not cut tombs for themselves out of the solid rock as did the ancient Egyptians.[4] MacCurdy,[7] Eaton[8] and Hrdlicka[3] have written of the methods of burial in the highlands. Bowman,[2] Hitchcock[13] and others have written of the miserable conditions under which the highlanders live. These things all have a relation to our problem.

THE TREASURE HUNTERS AND THEIR RESULTS

Treasure hunting was initiated in the Peruvian area by the conquering Spaniards immediately on their arrival. It has continued to this day. Gold and silver were common metals to the ancient Indians, and they possessed vast quan-

9. Reiss, W., & Stübel, A.: Necropolis of Ancon in Peru. A Contribution to Our Knowledge of the Culture and Industries of the Empire of Incas, Being the Results of Excavations Made on the Spot, 1880-1887. (Translated by A. H. Keane.)

10. Mead, C. W.: Old Civilizations of Inca Land. Handbook Series No. 11, American Museum of Natural History, pp. 1-111, 1924.

11. Moodie, R. L.: Paleopathology, "Diseases of the Ancient Peruvians," chap. 15, pp. 485-494, 1923.

12. Tello, J. C.: Introduccion a la Historia Antigua del Peru, pp. 1-48, 1922.

13. Hitchcock, A. S.: A Botanical Trip to Ecuador, Peru and Bolivia, Smithsonian Report for 1924, pp. 335-351, 1925.

Fig. 9.—Mummy of a child, about 4 years old (natural mummification from drying in the sun); from Lupo near Huarochiri, Peru. (No. 1147, San Diego Museum of Anthropology, at Balboa Park.) The teeth can be readily examined by the roentgen ray. The body was interred without wrappings and was placed in the contracted, sitting position. The soft tissues of such bodies as this one can be readily softened and examined by modern methods. Compare Williams, H. U.: Gross and Microscopic Anatomy of Two Peruvian Mummies, Arch. Path. & Lab. Med., 4:26-33, 1927.

Fig. 10.—Mummy of a young woman (natural mummification); from Lupo, near Huarochiri, Peru. (No. 1151, San Diego Museum of Anthropology, at Balboa Park.)

tities of them. So remunerative were excavations into many of the old ruins that often well-organized companies were formed for the purpose of exploitation. Human remains, having no monetary value, were cast aside as useless, exactly as has been done in Egypt[4] for thousands of years. Only one royal Egyptian mummy, that of Tutankhamen, was ever found in its own tomb. Similarly, today in Peru it is difficult to find unmolested burial places. I do not know what became of the royal mummies of Peru, of which Garcilasso de la Vega[14] tells us. They may exist somewhere.

The chief results of the activities of the treasure hunters in Peru is destruction and yet more destruction of the ancient relics of pre-Columbian Peru. The mad greed for gold led to the immediate melting down into ingots of priceless objects of ancient art in metal work, and we have little left in comparison to what existed even a short time ago.

THE HRDLICKA COLLECTIONS OF PRE-COLUMBIAN MATERIALS

A previous and fairly complete account of the collection at San Diego has already been given.[15] Dr. Ales Hrdlicka, of the United States Museum, visited Peru in 1913-1914 to collect from the edges of the opened graves (Fig. 2) of the coast, from the rock shelters (Fig. 4) and caves in the mountains, the skeletal elements preserved at San Diego and

The body was interred naked and in sitting posture. The incisors were lost. The length of the flexed body is 82 cm.; length of femur, 42 cm.; width across shoulders, 23 cm.; weight of dry body, about 6 pounds.

14. De la Vega, Garcilasso: Food of the Ancient Peruvians, in "Royal Commentaries," 2:355.

15. Moodie, R. L.: Studies in Paleopathology. XVIII. Tumors of the Head Among Pre-Columbian Peruvians, Ann. Med. Hist., 8:394-412, 1926.

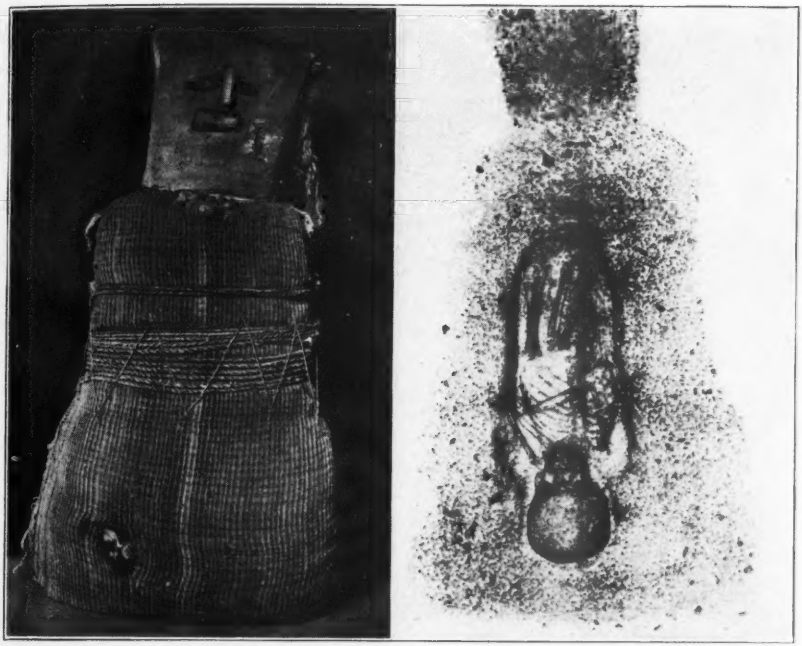

Fig. 11.—A pre-Columbian mummy-pack, from Collique, Peru, with false head, and features painted on or represented by metal. The cloth is of white and brown neatly woven material, of native manufacture. The ancient Peruvians excelled in their textiles. The height of the mummy-pack is 70 cm.; breadth, 57 cm.; diameter, 35 cm.; circumference, 158 cm. The adult mummy within is shown by the roentgenogram to the right to be upside down, but contracted. The mottled appearance of the pack as seen by the roentgen ray is due to clumps of sand and fine gravel which are included within the cloth covering. A great variety of mummy-packs are known from Peru, some of them containing three bodies. Roentgenologic examination of the collection of mummy-packs at Field Museum is under way and will yield much information. (Photographs after Baessler, Arthur: Peruanischer Mumien: Untersuchungen mit X-Strahlen, Fünfsehn Tafeln nebst erläuterndem Text, 1906.)

at the National Museum. There were 3,651 skulls alone. From this mass, Hrdlicka selected the premortem injured and pathologic elements to form at San Diego for the Panama-Pacific Exposition an exhibit of the paleopathology of Peru, the only collection of its kind in existence. (Fig. 7.)

In addition to the skeletal material, which he himself collected and labeled in the field, Hrdlicka assembled many objects of a cultural nature, notably a collection of slings, the most important weapon in Peru, as well as of obsidian flakes used in surgery.[16]

A disadvantage in material thus assembled is that there is no safe, reliable means of associating the osteologic elements. We may fit a jaw to a skull,

16. Moodie, R. L.: Studies in Paleopathology. XXII. Surgery in Pre-Columbian Peru, Ann. Med. Hist., to be published.

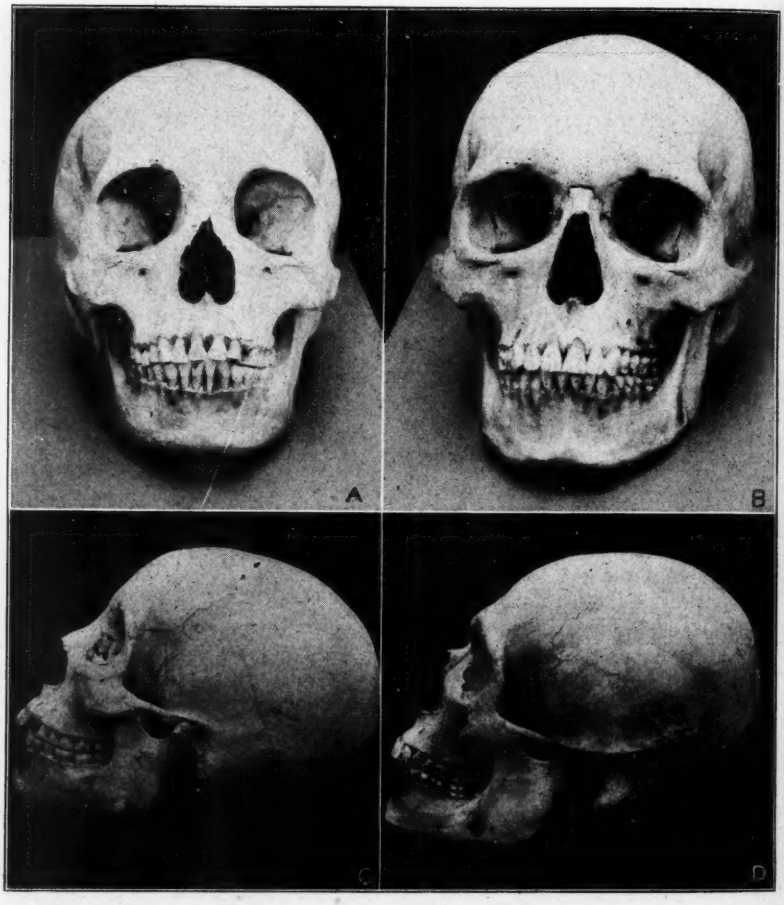

Fig. 12.—The normal dentition of two pre-Columbian Peruvians, male and female, from Chilca, Peru, collected by Ales Hrdlicka. *A & C:* The female skull (No. 226, San Diego Museum). *B & D:* The male skull (No. 979, San Diego Museum). Both skulls are normal with full sets of teeth. In *A* and in *B* the alveolar edge is broken down by accident and not disease. Roentgen-ray examination of the roots of these teeth, with the nasal sinuses, will be undertaken.

from the thousands of jaws present, but there is no assurance that that jaw belongs to that skull.

OTHER COLLECTIONS IN THE AMERICAS AND IN EUROPE

In addition to the collections in San Diego and in Washington, there are several which are worthy of note. At the University of California, housed in the Museum of Anthropology at San Francisco, there is an extensive collection of pre-Columbian Peruvian materials as-

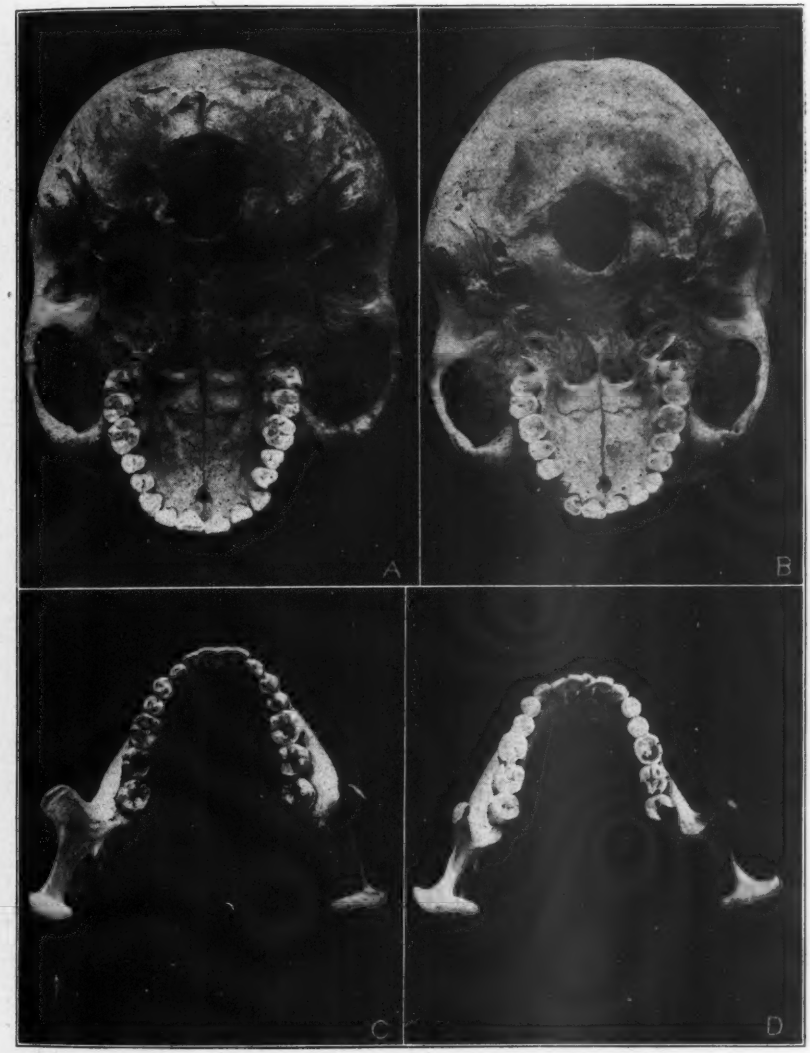

Fig. 13.—Skulls shown in Figure 12, *A* & *B:* Base of male and female skulls, showing palates and teeth. In the female skull *B*, the palate shows a small cyst, and one tooth is broken. *C* & *D:* Mandibles of male and female skulls. In the female jaw *D*, there is a defective incisor and a carious molar. These dentitions will be studied later and in much more detail. The purpose in showing these skulls here is to point out the wide range of material, from almost perfect specimens to fragments, on which to base a study of prehistoric dentistry.

Fig. 14.—Head of a pre-Columbian Peruvian male within a mummy-pack, pictured by roentgen ray without removing the wrappings. There is part of a second skull to the left. The teeth in the large skull were loosened by pyorrhea and some of them dropped out. Ribs and vertebrae obscure certain details. The mandibular canal is evident. The healthy roots of upper and lower teeth shown. Other roentgenograms taken from different angles will show further details of the conditions of the mouth, including the air sinuses.

sembled some years ago by Max Uhle. The potteries of this collection accompanied by accurate data, have recently been fully described by Dr. Kroeber and his associates. Potteries form our best basis for the establishment of an authentic chronology. On the hundreds of skulls present in that collection, a study of the teeth has been made, but it is so far unpublished.

The Field Museum of Natural History at Chicago acquired years ago a large assemblage from Ancon and other areas. Recently, further collections have been made, and the Museum is making roentgenograms of all mummy-packs, in connection with a study of the ancient Peruvians.

The American Museum of Natural History at New York possesses a wonderful collection from ancient Peru. Their material has never been discussed from the pathologic point of view, and it contains numerous specimens offering data.

Fig. 15.—A lateral view, as seen by the roentgen ray, of a large pre-Columbian male, showing the ravages of pyorrhea in the loss of all upper teeth save one, and that greatly eroded. The pituitary fossa is unusually clear. The heavy cloth wrappings of the mummy-pack obscure some details. Dozens of similar roentgenograms are on hand and should aid in an interpretation of the condition of the mouth in pre-Columbian people.

While a student at Harvard, Julio C.

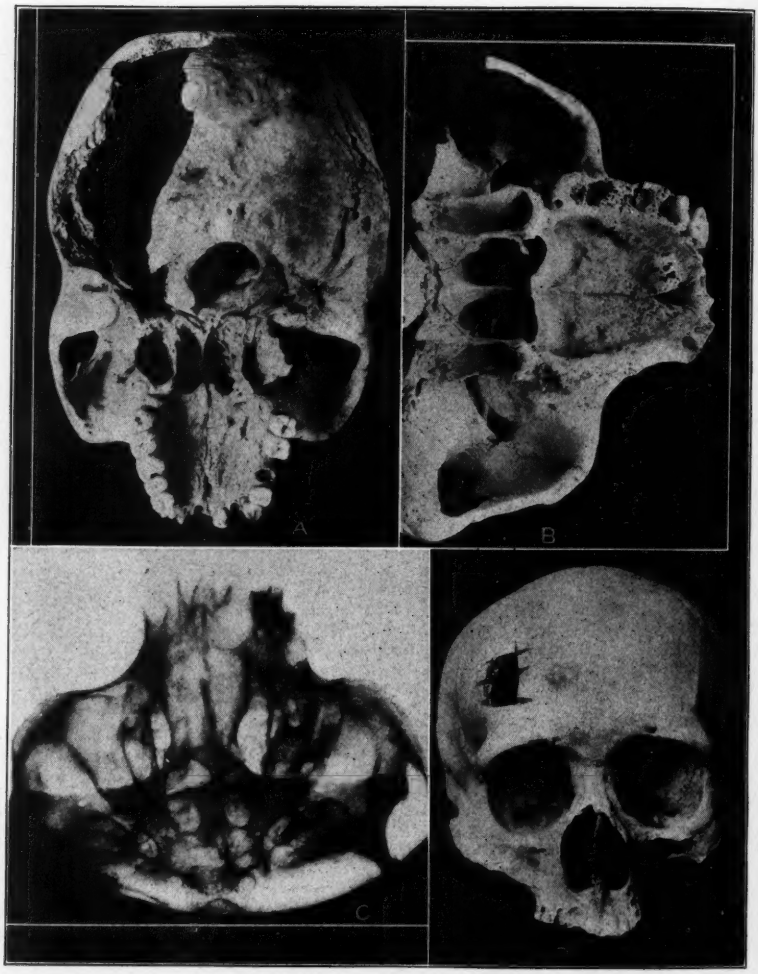

Fig. 16.—The skulls shown in this plate are preserved in the San Diego Museum of Anthropology at Balboa Park. *A:* Base of skull (No. 11), male, prehistoric, from an ancient fort at Cinco Cerros, Peru, near San Damian, in the highlands. An extensive, mortal injury by a blow from a mace in left occipital region, involves the mastoid. Teeth and palate are fairly normal. A molar is lost and the alveolar process is absorbed. This skull has an unusually heavy cranial vault. *B:* Palate and choanae of skull (No. 99) showing a large cyst on right palate; an old fracture of the left molar, and a small suppurative lesion on the frontal process of the left maxilla. The palate is practically edentulous, with absorption evident on one side and hypertrophy on the other. *C:* Roentgenogram of palate of skull (No. 99) shown in *B*. The cyst is indicated by the clear, circular area. *D:* A trephined pre-Columbian skull from Cinco Cerros, Peru, showing a greatly narrowed dental arch, with loss of teeth. The deflected septum indicates nasal catarrh. The trephined opening had not healed.

Tello deposited in the Warren Anatomical Museum a collection of trephined craniums. Other and smaller collections are housed in various museums.

An extremely important collection is being formed by Julio C. Tello at Lima, Peru, in the Archeological Museum and at San Marcus University.

Many of the great museums of Europe possess valuable collections, which will supplement the collections in America.

MORTUARY CUSTOMS

Methods of burial and other means of disposal of the dead form one of the most fascinating topics of anthropology. The different customs of peoples throughout the world, their similarities and differences, need not detain us here. Our interest in the matter is solely for the preservation of materials at our disposal for study.

Cremation seems not to have been practiced in ancient Peru. The charred condition of bones found in certain mountain caverns is doubtless due to accidental fires among the hundreds of grass-wrapped mummies; or intentional fires to drive out bats.[7]

Burial in the sand of the coastal area (Fig. 2) and of the mountains (Figs. 3 and 4), and other types of disposal in ancient Peru are elsewhere considered.[17] All skeletons in all types of burial are subject to a great variety of accidents which decrease the quality of the material for study.

MUMMIES

The fact that the ancient Peruvians prepared mummies of their dead indicates, I suppose, a belief in immortality if not resurrection. Peruvian mummies are not so carefully prepared as were those of ancient Egypt.[4] The bodies are seldom if ever closely wrapped. Grass and other plants, finely woven cloth, coarse, loosely woven cloth, pads of cotton, dressed skins, feather blankets and other materials were used in ancient Peru to form the mummy-packs, mummy-bales, mummy-bundles or mummy-sacks, as they are variously called. That these objects (Figs. 8-11) will yield valuable data on roentgen-ray examination is proved by Figs. 14-15.

EMBALMING AND MUMMIFICATION

In spite of statements to the contrary, I have seen no evidence that the Peruvians ever embalmed their dead. This matter is discussed at length in my paper on "Surgery."[16]

Mummification was entirely by drying, both on the coast and in the mountains.[16] The climate of Peru is especially adapted to this method of preparation. In the coastal desert, dessication was extreme. A body of about 160 pounds would be reduced, in a few months, to a weight of a few pounds. Nothing is known of other methods of preservation. Mummification did not have such a powerful influence in the lives of the ancient Peruvians as it did in Egypt.

SURGERY IN PRE-COLUMBIAN PERU

Although the pre-Columbian Peruvians suffered serious afflictions of the oral region (Figs. 13-18), they seem not to have had the slightest notion of dentistry. The nearest approach to oral surgery[16] is an example of excision of an area of the nose, upper lip and premaxillary region diseased by uta, a phase of leishmaniosis prevalent in ancient Peru. I have suggested[16] that this diseased area had been cut away with a sharp obsidian flake. Exodontia had not occurred to them, in spite of a prevalent pyorrhea.

17. Footnotes 3, 7, 9, 15, 16; also Moodie, R. L.: Studies in Paleopathology. XXI. Injuries to the Head Among Pre-Columbian Peruvians, Ann. Med. Hist., 9:298-328, 1927.

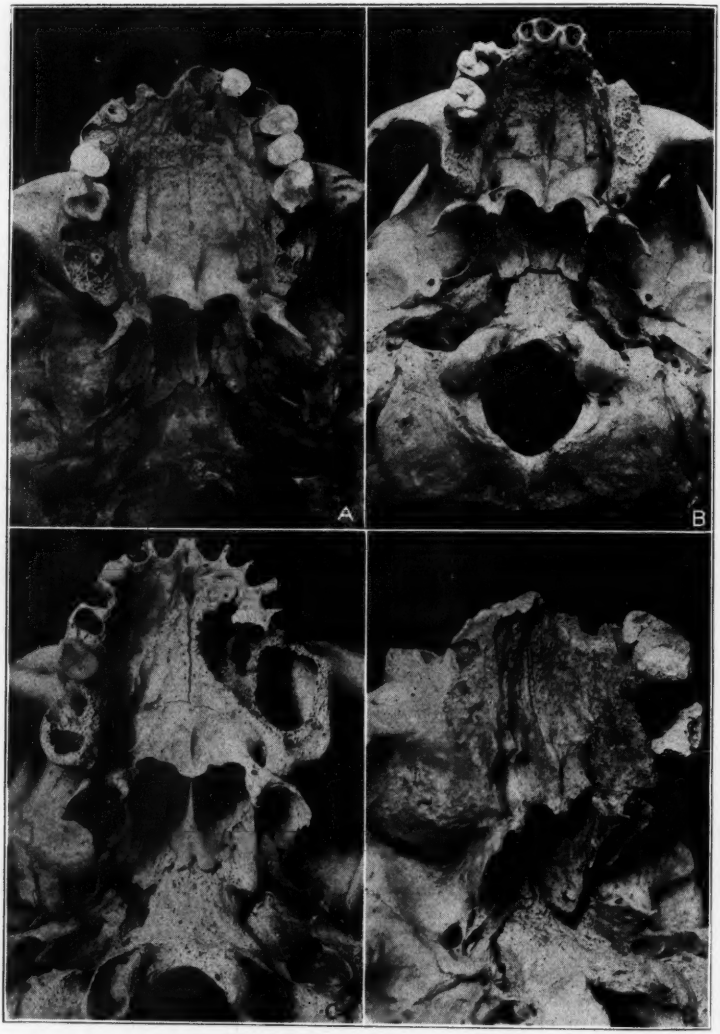

Fig. 17.—The palates of pre-Columbian Peruvians as exhibited by craniums in the San Diego Museum of Anthropology at Balboa Park. *A:* Palate of skull (No. 6) from a male, from Lomas, Peru, exhibiting loss of teeth by accident and disease. The palate is very wide and presents a number of interesting features for later study. *B:* Almost edentulous and diseased palate of a male from Chilca, Peru. (No. 126.) The cranial vault shows a number of injuries described in "Studies in Paleopathology." (Footnote 17, last reference.) *C:* A remarkable prehistoric palate of a skull (No. 157) from a female, from Ancon (Footnote 9), on the coast of Peru. (Compare Fig. 1.) An extensive erosion of the palate on the right, even penetrating extensively into the maxillary sinus, indicates a soft tumor of undetermined nature. Ravages of pyorrhea are evident. The two teeth remaining are worn down. The rarest palatal condition thus far seem among pre-Columbian pathologic material from Peru is here shown. *D:* A curious type of palate in skull (No. 174) from Cajamarquilla, Peru, shown obliquely to bring out the excessive deposits of salivary calculus on the stumps of the three remaining teeth. Hrdlicka calls these unusual deposits "tartar tumors." They will be described more fully later.

Dermal abscesses were drained, but alveolar abscesses took their course (Fig. 18*B*). A stone lancet was used in phlebotomy, yet tumors held their sway (Fig. 17*C*). Trephining and cauterization of the head[18] had a wonderful development, yet a large portion of the people were edentulous before they reached 40 years. This seems an inconsistent development, yet those are the facts today.

LONGEVITY IN ANCIENT AND MODERN PERUVIANS

It would seem that the length of life in pre-Columbian Peru was relatively brief. Fifty years would be old age. This it seems to me to be especially so in the mountainous areas, where life was terribly hard. Yet MacCurdy[7] identifies an age of 70 years on some of his material. Recently (1925), Hitchcock[13] has pictured a modern Indian woman who was said to be 100 years old. This question thus forms a problem for investigation. A study of the teeth may help, but I believe that many lost the teeth early.

EVIDENCES OF SENILITY IN PRE-COLUMBIAN PERU

The only evidences of senility available to anthropologists are the conditions of the skeletons and the nature of the teeth. The total lack of ancient written records in ancient Peru requires that we fall back on the so far unstudied conditions of the body. The apparent prevalence of pyorrhea and the suggested acquirement of edentulous palates and jaws would be of scant value unless much accessory material were tabulated. Senile atrophy would have little time to make its effects noticeable in the rush and tumble of ancient Peruvian life. Apparent evidences of senility must be checked by nutritional disturbances, such as osteomalacia, an example of which I have seen from ancient Peru. The problem of senility is an open one, and it must be developed in connection with other studies. We do not know at present what senility was in ancient Peru.

TYPICAL PREHISTORIC DENTITION OF MALE AND FEMALE

The conditions of the palate and teeth in a large collection of prehistoric Peruvians from the mountains has been all too briefly discussed by MacCurdy.[19] He says that the denture was observed in 422 cases. The collection that he studied is no longer at Yale University, having been returned to Peru. Its study in detail would be well worth while.

The two skulls, male and female, from Chilca, Peru, shown in Figures 12-13, will, because of their perfect preservation, practical freedom from disease, undeformed and moderate dimensions, be taken as presenting typical prehistoric conditions of the head. We shall refer all apparent variations to the conditions seen in these two skulls. A more detailed description, with measurements of important oral features, will be given later. It will be seen in Figure 13 *A* and *B* that the palates are of practically the same types, and that the arrangement of the teeth is uniform in the two heads.

As a matter of caution, we should early establish the fact that the territory of ancient Peru was occupied at various times by people of different somatology, and our reference to these two skulls as typical is entirely arbitrary. We must have some standard for comparison, and these skulls will serve that purpose. A detailed description of the mouth area is not needed in this preliminary outline of the work. Figures 12-13 will serve our present purpose, which is to establish a standard for comparison.

18. Footnotes 11 and 16.

19. Footnote 7, pp. 272-278.

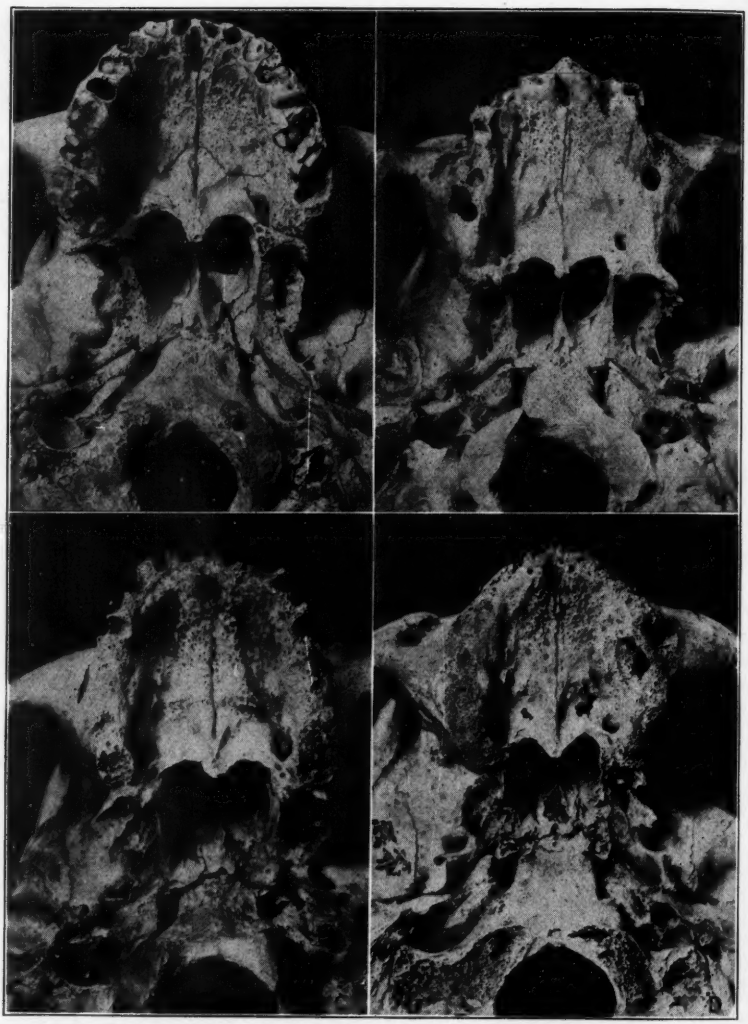

Fig. 18.—Four pre-Columbian Peruvian palates seen on craniums preserved in the San Diego Museum of Anthropology at Balboa Park. *A:* Skull (No. 1), representing a peculiar individual. The heavy walled spongy vault is dented over with no less than twenty sling-shot injuries, only one of which penetrated to the inner cranial table. It is suggested (Footnote 17, last reference) that he was the village fool, in the Nasca Region of Peru, at whose head the children on their way to the pasture lands with their flocks took a matitudinal shot with their slings, with which they were extremely expert. His skull would be very difficult to fracture. It is a pity that the teeth were so badly broken by being kicked around on the edge of the grave. The dentition appears to have been of a sturdy, massive type. *B:* An elderly man from the Acari Valley, Peru. (Skull No. 2.) An opening on the right doubtless drained a sinus abscess. Only two alveolae remain. Loss of the teeth may have been due to pyorrhea. *C:* A male (No. 3) skull from San Damian, Peru, in the highlands, exhibiting a palate from which all the teeth were lost by disease. *D:* A prehistoric male skull (No. 8) from Cinco Cerros, near San Damian, Peru, with a completely edentulous palate. The opening into the maxillary sinus appears to have been accidental.

THE ANCIENT PERUVIAN PALATE

There has been no study made of the ancient Peruvian palate. Its relation to bodily parts and modification by the activities of other parts of the body need no mention here. It shall be a part of our task to determine whether the conditions of the palate indicate any particularly cultural aspect such as is shown by the palates of the skin-chewing Eskimos. That the palates of prehistoric Peruvians reveal evidences of severe disease is evident from an examination of Figures 13*B*, 14, 15, 16, 17 and 18. Modifications of the palate by cranial diseases and by intentional deformation of the head will be discussed from the material available. The form of the palates shown in Figure 13*A* and *B* will be regarded as typical, and to these will be referred all variants.

TUMORS OF THE MOUTH AND OTHER PARTS OF THE HEAD

The influence of a huge cranial tumor, *hyperostosis cranii,* upon the form of the head and the shape of its parts, has already been outlined in part, in a previous contribution.[15] On dry, osseous material, it is always difficult, with results uncertain, to determine the exact nature of neoplasms whose ravages may be evident, as in Fig. 17*C*. In the case of the hyperostosis of the cranial vault, it was possible to make an exact diagnosis because similar modern tumors were known, in the interpretation of which I had the aid of Phemister and Cushing. It sometimes takes years of painstaking comparison to be sure a diagnosis of an ancient lesion is correct. The study of cranial tumors forms an important phase of our program.

THE PREVALENCE OF PYORRHEA ALVEOLARIS IN PERU

The examination of hundreds of dry skulls by inspection and of the oral region in scores of prehistoric mummies from Peru by means of the roentgen-ray reveals an appalling loss of teeth by an absorptive alveolar osteitis. The conditions shown in Figures 14, 15, 16*B* and *C;* 17*B, C* and *D*, and 18*B, C* and *D* are unrivalled by any other ancient people of which I know.[20] We know so little of the food of prehistoric Peruvians, discussed in a later section, that we are unable at present to account for the prevalence of this disease on the basis of their food content, if this has any relation to pyorrhea. Further study of abundant material will give us many statistical data which may open the field for further study of this important problem. All we can do at present is to present the evidence as we see it, letting it lead where it will. MacCurdy,[7] on the basis of 422 dentures from the highlands, established for pyorrhea an incidence of only 13 per cent.

CARIES

The distribution, geologic origin and occurrence of dental caries in ancient times has already been given.[11] Among tertiary mammals, caries is extremely rare. It may have been prevalent in ancient Peru, but I have seen little evidence of it. The last lower right molar shown in Figure 13*D* is apparently carious. MacCurdy[7] discusses briefly the low incidence of caries in the material he studied. The disease may be intense in certain regions—a matter to be established later.

THE USE OF COCA

The "divine plant of the Incas" is a shrub whose leaves, mixed with lime, ashes or other alkaline substance, have been chewed and held in the mouth as a quid by the people of Peru over many

20. Ruffer, M. A.: Studies in the Palaeopathology of Egypt, 1923.

centuries. The cocain thus extracted deadened all sensations of fatigue or hunger and increased the resistance of the users of the drug-producing leaves so that they had almost unbelievable endurance. In the mountains, especially where mountain trails are narrow and animal burden-bearers scarce, the Peruvian Indian is able to carry heavy loads for great distances.

Small packages of coca leaves are still sold in the wayside markets of modern Peru—a custom of centuries. Prehistoric mummies often were buried with their vessels of leaves and lime or ashes attached to their girdles; facts which establish the prevalence of the custom in early times.

Our particular interest in the coca-chewing habits of the Peruvian Indians is in the possible effect on the teeth of the retention of lime and leaves within the mouth for long periods of time. I do not know at present whether this topic has been studied.

FOOD IN ANCIENT PERU

The importance of food, its nature and its quantity, as regards the organs of the mouth is very great. We have the statements of Garcilasso de la Vega,[14] a son of a Spanish father and an Inca princess, as to what he remembered about food in Peru during the reign of the Incas. His statements can hardly be regarded as of scientific value, but his work is the best we have. A study and identification of plants buried with mummies have revealed much of interest, but the whole problem needs to be reviewed in the light of its importance as regards the organs of the mouth. The tomato, maté, cocoa, tobacco, quinoa, potato, peanut, maize and other plants may have furnished the ancient Peruvians with food. They had for centuries domesticated two species of camels, a dog and guinea-pigs. These doubtless served as food as well as for other purposes. Game and fish formed an unknown share of their diet, but of these matters little is known or, so far, even conjectured.

CRANIAL DEFORMATIONS

There are three ways in which cranial deformation is brought about among primitive people. Binding the child on a cradle board, with the back of the head resting against a resistant surface produces a flattened area, either right or left, upon the occipital region of the head. Many of the prehistoric Peruvian skulls show this lop-sided deformation. Two notable examples, with tumors, have been discussed.[15]

Fronto-occipital or "flat-head" deformation is an intentional modification of the skull by tightly binding flat hard surfaces on the forehead and occiput, the head growing up into a wedgelike peak. The modification of cranial form was often excessive. The influence of the deformation of the vault on other parts of the skull must have been great.

"Aymara," or cone-shaped deformation, was brought about by binding the head spirally with cloth, from infancy, producing an elongated cranium. It is not often one finds an "Aymara" skull which has been either injured or trephined. "Aymara" skulls may represent a specially privileged class of folk.

Numerous examples of these three types of plagiocephalic craniums are preserved in the San Diego Museum.

THE RELATIONSHIP OF MALOCCLUSION TO RHINOLOGIC CONDITIONS*

By ABRAM HOFFMAN, D.D.S., F.A.C.D., Buffalo, N. Y.

I APPRECIATE the courtesy accorded me in being invited to present to this body of special workers in the field of medicine and surgery a few ideas on our lines of endeavor, with the hope of showing that our fields are more intimately connected than might be supposed by the casual thinker.

At the outset, allow me to express a consciousness of my meager knowledge of rhinology and laryngology and to say that I have a selfish desire to leave here with more information than I bring. If orthodontia were the sole subject to be discussed, I would gladly give you my all. I believe that I voice the sentiments of my confrères.

The topic assigned to me is "The Relationship of Malocclusion to Rhinologic Conditions." I have tried to weave into the paper a few of the conditions causing dentofacial irregularities that should be of interest to the rhinologist—those having a direct effect on your work; those oral abnormalities which decrease the size, shape and function of the respiratory passages, but, more especially perhaps, those influences commonly associated with mouth-breathing.

Rhinology, as the word is used in this paper, is that branch of health service having for its object the prevention and correction of diseases of the nose, throat and associated structures, while orthodontia has for its object the prevention and correction of irregularities of the teeth, jaws and associated structures. The borderline or interrelationship between our two professions seems to be within the term "associated structures."

M'Kenzie, an English surgeon, says[1]:

> The subject of palatal and maxillary deformity has been discussed "ad nauseum" in rhinological circles and we have long recognized that there are a few cases in which the removal of adenoids fails to cure the patient of the mouthbreathing habit. Of these patients a small number remain mouth breathers from sheer inertia of habit, but by far the greatest number do so because of the malocclusion of the teeth which results from a deformed palate. This fact, as I have said, has long been admitted by the rhinologist. But it is only of late years that we have begun to learn from the orthodontist that this hitherto impregnable rock of pathology can be remoulded nearer to a normal shape in such wise as to restore the power of breathing through the nose with lips closed; an advance in therapeutics which, in this country (England) at least, is not yet so widely known as it ought to be, either by the medical men or by the laity.

Leaving, for the moment, the thought as expressed by M'Kenzie, for he has touched on just one phase of the forms of perversion of mutual interest to the rhinologist and orthodontist, I wish to refer briefly to some of the etiologic factors in the production of malocclusion

*Read before the Chicago Association of Orthodontists and representatives from the Chicago Laryngological Society, Jan. 26, 1928.

1. M'Kenzie, Daniel: Internat. J. Orthodontia, 1:9 (Jan.) 1915.

or irregularities of the teeth, and you will observe the intimate relationship between our specialties and how the causes blend and are in the main inseparable.

It may be stated almost as a fundamental principle that any influence which decreases the size of the dental arches at once becomes of interest to the rhinologist because of the resultant diminution in size of the respiratory passages and the consequent or subsequent effect on the accessory sinuses. Furthermore, the maintenance of normal atmospheric pressure, from within and without the head, is a potent factor in the development of the dental arches. With mouth-breathing, this equality of pressure does not exist. The air does not pass through the nose and sinuses during inhalation and exhalation and there is no favorable resultant pressure exerted on the walls of the nose. The pressure and stimuli that are exerted are abnormal and result in pathologic conditions, an arrested development and a perverted form of the bone.

That the shape and size of bone may be largely influenced by use and environment has long been recognized. This takes place notwithstanding the architectural plan of our Creator. Legs become bowed; backs stooped; spines curved; fingers bent; faces narrowed; mandibles modified; all as the result of function and environment. The foregoing statement presupposes malfunction and pathologic conditions, and just as these perversions work negatively, so may man, through his ingenuity, modify the shape of bone almost at will, other conditions being favorable. As our discussion at this time centers around the structures of the head and face, I shall confine my remarks to these parts.

Bone is essentially a plastic tissue and particularly responsive in form and structure to the demands of function, to the application of stress and strain or to the irritation of inflammation. Inflammation does three things to bone: it either kills it, and we have dead bone, that is, necrosis; or it causes absorption, and we have a region of rarefaction; or it stimulates it to further development, and we have bone hyperplasia.

The action of orthodontic appliances becomes of interest to us because of the stimulation which they give to the bone cells. If the pressure from our appliance is mild, gentle and continuous, we will bring about the third condition of inflammation as just mentioned and cause bone formation. If the pressure is carried beyond this point, we find ourselves confronted with a more active inflammation, resulting in absorption, and we defeat our object. As the bony framework is changed in its form, the action and reaction of the muscles of respiration, mastication, deglutition and expression, owing to the changed environment, become of interest to us, for, from their stimuli, the supporting bony framework of the dental apparatus continues to develop a new contour with a resultant increase in the size and alteration in shape of the respiratory passages.

The time honored and readily accepted theory that heredity is responsible for many jaw deformities is now accepted with considerably more than a grain of salt. It is a fact that hereditary influences are recognized, but when it comes to the actual dental deformities, we feel that it is the predisposition rather than the actual deformity that is transmitted.

Among the systemic or constitutional influences of dental irregularities with

particular reference to those which inhibit the natural increase in the size of the jaws and thus bear upon the development of the respiratory passages, we find:

(a) Rickets.—This is a disease of malnutrition characterized by faulty bone formation. The poorly calcified alveolar bone affords an insufficient support to the teeth in mastication; the muscles and mechanical stresses cause a narrowing of the maxillæ and a widening of the mandible; the angles are more obtuse and turn outward from the sagittal plane, while the molars lean inward toward the plane. In these cases, the deciduous teeth erupt late and are lost early, while the permanent teeth erupt late and in varying degrees of malposition. Many cases of malocclusion of adult life can be traced to this fact and, without doubt, many cases of nasal stenosis have their inception in the narrowed upper dental arch associated with rickets.

(b) Tuberculosis.—This disease undoubtedly has an effect on the teeth but the reactions are not well understood at this time. The deciduous teeth erupt early and are apt to be lost late because of faulty absorption of the roots. Thus, the permanent teeth, which erupt late, are apt to be guided out of alinement because of the slow absorption, and erupting out of alinement, usually to the side, means a shortening of the dental arch, with its effect on the size of the palate and the floor of the nose.

(c) Exanthems.—The eruptive fevers of childhood usually leave their mark in the form of atrophy of the enamel, which affects the size and shape of the tooth and frequently destroys the approximating contact points, the inclined planes of the cusps, etc. When normal, these factors, through their wedgelike shape, in mastication have the tendency to spread or cause the growth of the upper arch to its proper shape. This aid is lost when the teeth are atrophied.

(d) Maldevelopment. — Under this head, we might also include certain prenatal conditions, environment, faulty diet in infancy, lack of mastication and disuse of the teeth. These conditions imply not an insufficiency of food but a lack of the right quality, and, in turn, they imply a lack of a good, healthy circulation of blood to the surrounding structures, with a resultant lack of growth and development.

(e) Endocrine Disturbance. — There is a growing belief that the internal secretions may have a definite bearing on the development of the teeth and associated structures. Much remains to be proved in this connection.

There are several conditions working in more or less the same manner as the foregoing, decreasing the size of the palate or inhibiting its growth, which might quite properly be classed as congenital conditions. Among these are:

(a) Syphilis.—This condition affects the size, shape, number and position of the teeth.

(b) Microglossia.—This is an arrested development of the tongue, accompanied by a narrowing of the palate.

(c) Cleft Palate.—This condition is too well known to need elaboration here, except to say that, after surgical correction, the maxillæ are so reduced in size as to definitely indicate orthodontic treatment in the effort to restore the nasal chamber to somewhat near normal size.

The next group that we might mention includes many local and acquired conditions that may have a bearing on the arrested development of the maxillæ. There are many factors of "dental" character which we will pass over, in-

cluding only those of interest to the rhinologist. These can be grouped under two sub-heads: (a) habits and (b) mouth-breathing. Furthermore, these two factors have so much in common that it will be better not to try to separate them, but to discuss them together.

There are many pernicious habits that have a definite bearing on the shape, size and formation of the upper jaw, with either a direct or a secondary influence on the tissues of the nose. As the nasal chamber, even with normal dental arches, is not very large, it becomes evident that any condition which tends toward encroachment in the slightest degree should be overcome.

The use of baby "pacifiers," thumb or tongue sucking, cheek or lip biting, certain positions during sleep and the presence of adenoids all have a tendency to produce a lateral narrowing of the maxillary bones, with a subsequent shortening of the upper lip. All of these conditions are usually associated with a high palate, a deflected septum and a mouth-breathing habit, which may almost be classed as permanent. Not only is it difficult to break these habits when once established, but the problem of successful orthodontic treatment develops in a direct ratio. Noyes,[2] of Chicago, speaking on habits, believes that many of the "sucking habits" are the result of hunger or an irritation of the nasopharynx and that the habit as practiced relieves these sensations through an increased flow of saliva and a moistening of the membranes.

The manner in which the infant receives its food has a relationship to the development of the maxillary bones and nasal sinuses. The mild sucking, almost "pour-it-down," action of the muscles in bottle feeding is not to be compared with the vigorous pumping and swallowing that accompanies breast feeding when considered from the standpoint of activity. Hellman has shown, in his investigations and writings, that bottle feeding is a frequent cause of malocclusion and, as such, it may be an etiologic factor in the production of adenoids. Bottle feeding brings but a few of the parts into use, while breast feeding stimulates all of the tissues to strong action.

The presence of adenoids, which has a very pronounced influence on the dental structures, has long been considered the chief cause of mouth-breathing. This lymphoid tissue is present in all children but its presence is the direct cause of mouth-breathing only when it is infected and congested sufficiently to come in contact with the soft palate and close the naso-pharynx. The obstruction is sometimes of small size and becomes an annoyance only when the child is lying down. When this is the case, it causes no little concern to the orthodontist.

Because there is no evidence of hypertrophied tissue when a child is presented for orthodontic examination, it does not necessarily follow that such tissue is not or has not been present. Those types of malocclusion wherein the mandibular structures are distal to their normal relationship to the maxillary structures (commonly spoken of as "a protruding upper jaw with a short, functionless upper lip, a high narrow palate and a receding chin") we find to be an almost unfailing diagnostic sign of nasal obstruction past or present. The offending tissue may have been removed early or outgrown early, but the mischief, dentally, has been done.

It so happens that these pathologic conditions are usually present in early

2. Noyes, F. B.: Chicago Dent. Soc. Bull., 3:6 (Feb. 27) 1923.

childhood when the bones of the face and the dental tissues are developing rapidly and at a time when the injurious influences may be most potent. Hence, it should be borne in mind that symmetry or asymmetry in the lower third of the face is largely dependent on these conditions as well as on the eruption of the teeth and the positions which they are to assume. If conditions exist that produce an abnormal relationship mesiodistally of the lower teeth and structures to the upper, we are in for orthodontic trouble, regardless of the age.

In passing, it may be well to mention that certain investigators, notably Weinberger of New York,[3] who have carried on embryologic studies, are of the belief that some at least of the facial deformities that we are considering are due to positional influences on the fetus during intra-uterine life. With this, it is reasonable to assume that the deformities may be the direct or exciting cause of the pathologic conditions in the nose and nasopharynx soon after birth, for "snuffles" and coryza are often present thus early.

At birth, the roof of the mouth, normally, is nearly straight or horizontal; the maxillary sinus is not present; the inferior turbinates lie close to the floor of the nose, and the septum is vertical. If the child breathes normally and continues to do so as development takes place, the nasal chamber and antrums will develop; the septum will continue to grow downward; the floor of the nose will be carried downward; the maxillary bones will affect the growth of the nasal bones, and anything affecting these several bones will have its influence on the development of the oral cavity. The reverse is also true.

3. Weinberger, B. W.: Proc. Am. Soc. Orthodontists, 1916-1917.

The first permanent molars are by far the most important teeth in the dental arch in function and influence. Theirs are the first permanent tooth germs formed, and, erupting posteriorly to the deciduous denture, they assume their positions with a remarkable constancy in the line of the dental arch, directly behind a normal deciduous denture. They are the largest and firmest in their attachment, and, therefore, most important in the function of mastication. The length of their crowns determines the vertical separation of the jaws, the length of bite and the artistic proportions of the lower third of the face. Being the first of the permanent set to erupt, they influence the positions of those erupting later, either anteriorly or posteriorly to them.

As the teeth of the opposing jaws erupt and come into contact, and if the inclined planes formed by the cusps or other surfaces of the teeth meet under proper or favorable conditions, we shall have normal occlusion or "regular teeth." Conversly, if the planes meet under improper or unfavorable conditions, we shall have malocclusion or "irregular teeth"; and it is here that the normal or abnormal use of the nose and associated structures in breathing plays such an important part in the development of the denture and the face.

The following extract from the pen of Stanton of New York is of interest:

> In the normal breather the mandible is raised by the elevators and the teeth brought into normal occlusion and, as the act of swallowing is performed, the tongue expresses the air from between itself and the roof of the mouth, the lips are sucked down upon the teeth, the lower lip binding over the lower edge of the upper incisors. The tensor and levator palati having raised the soft palate, it is then allowed to drop upon the dorsum of the tongue, shutting off the oral cavity. The teeth drop apart just free from occlusal contact, the mandible is sus-

pended by atmospheric pressure, and the muscles of the cheeks and lips are in repose. In normal respiration, there is an exchange of air in the accessory sinuses, and the veins are emptied at the base of the brain. In swallowing, the tensor and levator palati open the orifice of the eustachian tube and the exchange of air is made in the middle ear.

Now let us consider the mechanics involved when the *nose is occluded* from any cause, and it becomes necessary to open and use the mouth for breathing. The muscles that depress the mandible are attached on the inner side of the horizontal ramus, and with each inspiration the muscular pull is a backward one upon the mandible. This section in time causes the bone to modify its shape and brings the lower teeth distal to normal. After the muscles have locked the molars in this distal relation, all the lower teeth that are erupted at a later period must assume a similar distal malrelation, and the mechanics of this malocclusion is constantly operating to mold and alter the bones in accordance with its needs.

In mouth-breathing, the vacuums above described are not created, consequently the tongue is not sucked tightly against the palate and we have a *lack of widening* of the upper arch. The lips are not drawn against the teeth, and the upper lip is so little used that it exerts but slight influence on the upper anterior teeth, while the lower lip instead of binding over the lower edge of the upper incisors turns or rolls outward and on account of the malrelations of the two arches, the lower lip is forced in between them and becomes a factor in pushing the upper anterior teeth farther forward. The bones of the face are now subjected to a perverted mechanical action of the improperly locked teeth, to perverted muscular action due to the altered functions of the mouth and nose, and to the altered mechanics of having the air pass through the mouth instead of the nose. The bones are consequently molded into entirely different structures than were intended for the individual, in response to the altered mechanics. The nose and accessory sinuses present an entirely different appearance due to their altered functions. There is an asymmetry of the bony structure and a pathological condition of the soft parts.

In orthodontic treatment of these cases it would seem logical, if these premises are correct, to establish at the earliest possible moment the normal forces that are operative in the normal breather. First, the nose, nasopharynx and throat must be cleared of any obstruction or disease, and second, the teeth must be placed in normal occlusion and a normal lip function established to allow the mandible to be suspended by atmospheric pressure, maintained by the tongue and lips. An approach to normality not only in the nose, but also in the mouth, must be made before true normal respiration can be established. Again if the premises are correct, that the bones of the face are altered by the perversion of the forces of development due to the improper locking of the teeth and altered respiration, we can only expect an approach to normality if these unbalanced mechanics are corrected at an early age.[4]

The foregoing type of malocclusion is known as "distoclusion." It is also referred to as Class II, Angle's classification.

A second type of interest to the rhinologist is "mesioclusion" or Class III. It is characterized by a mesial relation of the lower teeth and structures to the upper, with a prognathous lower jaw, often seriously marring facial balance.

In considering this type of deformity we have one which is less frequently attributed to pathological conditions of the nasopharynx and throat than the former, for the reason that the etiology of this type includes a number of other causes, but notwithstanding this fact, the writer is convinced that numerous cases of this type are the result of hypertrophied and infected tonsils. Such a statement does not imply or say that there are no cases of enlarged tonsils in which the occlusion of the teeth is not correct, for such a statement would not only be sadly lacking in proof but ridiculous on its very face.

The faucial tonsil lies on the superior constrictor of the pharynx and between the palatopharyngeal muscles behind, and the palatoglossus in front. When diseased it may increase in size in an inward, upward or forward direction. It is its forward growth which has a direct bearing upon the beginning (at least) of some deformities of

4. Stanton, F. L.: in McCoy, J. D.: Applied Orthodontia, Philadelphia: Lea and Febiger, Ed. 1, 1922, p. 83.

this class. The forward growth of the tonsil brings it in close apposition with the posterior part of the mandible, and because of the irritability of the hypertrophied tonsil, the mandible is moved unconsciously forward and held there, aided by involuntary and reflex muscular action both of the tongue and adjacent muscles. The result brings increased space around the inflamed tonsil and relief from pressure. Relief is also obtained by projecting the tongue, into the sides of which are attached the palatoglossus muscles, which compose the anterior part of the fauces, and which is to a considerable extent carried forward with it, thus giving more room for the swollen gland. But to project the tongue and still keep it within the mouth, the lower jaw must also be projected and this malposition of the jaw when maintained for months or years, inevitably becomes fixed through the changed occlusal relation of the teeth, made necessary by the mesial position of the lower arch. The accommodation of the other structures of the face to the altered position of the jaw renders this deformity one of the most unsightly and distressing to which the human face is subject.

These cases may be termed progressive, for when the normal occlusion of the teeth is lost there is nothing to prevent the lower jaw from very gradually coming forward, even though all causes have been removed. This is easy to understand when we consider the fact that the forward movement of the mandible is one of its easiest movements; and when the restraining influence of the upper teeth due to their overlap of the lowers is removed, there is nothing to prevent the modification of the bone in form or relation in response to the changed mechanics of occlusion.[5]

It would be interesting to know just how much orthodontic treatment increases the capacity of the nasal chambers, or how much the floor of the nose is lowered or the deflected septum straightened. These things are all problematic, but that some of these things are accomplished in a greater or lesser degree must be plainly evident from a comparison of casts such as may be found in the collection of any experienced orthodontist. Hellman, of New York,[6] and Ketcham of Denver,[7] have both shown, diagrammatically, favorable results of this nature on the roof of the mouth and in the lateral enlargement of the nasal chamber. We have had no postmortem examinations to determine these things.

My own observation and belief is that, with the younger patients, the sinuses are increased in size, the deflected septum is favorably influenced and the distance from the floor of the nose to the roof of the nose is increased through the growth of the lateral walls of the maxillary bones. I believe, too, that the expansion of the dental arches in older patients is accompanied by improvement in the nasal structures, although not to the same degree as in the younger patients. It cannot be otherwise for, as has been stated elsewhere, our problem is one of causing bone growth and development. The changes may be more or less immediate because of the mechanical principles involved, or perhaps it is better to state that the stimulation of the bone cells results in an improved metabolism and development that continues for some time after. The immediate effect of our appliances is more directly concerned with the alveolar process, but the ultimate result is on the supporting buttresses through the improved circulation of blood, muscular stimuli, and action and reaction in mastication and respiration.

A few years ago, some of our workers undertook a forcible and rapid method of opening the intermaxillary suture as a means of gaining arch expansion and increasing nasal space. Like most fads,

5. Footnote 4, p. 79.

6. Hellman, Milo: Internat. J. Orthodontia, 3:262 (May) 1917.

7. Ketcham, A. H.: Internat. J. Orthodontia, 2:15 (Jan.) 1916.

it had its trial, and now we hear but little about it. It was wrong in principle. Tooth movement may be likened to the stretching or warping of bone. It involves the building up of tissue and the absorption of tissue; a physiologic development and not a pathologic condition. It contemplates developmental changes through pressure stimuli produced by delicate appliances with the forces gentle, constant, uniform and under control.

Notwithstanding the foregoing statement, Dewey,[8] of New York, is convinced that it is possible to open the intermaxillary suture and has done so experimentally on dogs with no seeming ill-effect. Bone has filled in the open suture and the nasal cavity has increased in width. This has been revealed by both postmortem and histologic proof.

The orthodontist is often asked, "What can be done to break the habit of mouth-breathing?" and I suppose the rhinologist is asked the same question. We all would like to give a favorable reply. In the opening paragraph, reference was made to an interrelationship of our professions through the term "associated structures," and I think the answer is largely contained therein and may be summarized in the following paragraphs.

The first step in the treatment of the deformities of the jaws that we have been considering is the removal of the cause, whether or not malocclusion is actually present or is but impending. As I understand it, if the hypertrophied adenoid tissue is removed before the age of about 10 years, there is likely to be a recurrence which will seriously interfere with orthodontic success, and this may account for some of our failures to "hold" distoclusion cases. Even if it seems probable that a second operation will be needed, adenoids and tonsils should be removed at an early age.

The distoclusion cases in which the rhinologist has operated later than at about 10 years of age seem to respond to orthodontic treatment and hold the new occlusal relations more favorably than the former, provided, the cusps of the teeth have not been worn, resulting in the loss of the favorable influence of pronounced cusp interdigitation. This would seem to indicate the necessity for periodic examinations for the recurrence of hypertrophied nasal or pharyngeal tissue in the patients operated on at an early age. Unquestionably, the character and quality of voice and speech is much improved as the result of our joint efforts.

Most orthodontists would advocate early treatment in mesioclusion or distoclusion cases or in such other instances wherein there is, or wherein there is likely to be, a lack of proper facial balance. The successful contouring or building of the bones of the face can be accomplished and controlled with more certainty if undertaken in early childhood. In this instance, "early" may be accepted as meaning from 4 to 6 years of age. Baker, of Evanston,[9] and Chapman, of London,[10] have written interesting articles dealing with the age for orthodontic treatment and both have outlined the advantages of "early" treatment as compared to the state of development of the denture and the bones of the face.

In those cases wherein a serious interference with facial balance is not antici-

8. Dewey, Martin: Practical Orthodontia, Ed. 4, St. Louis: C. V. Mosby Company, 1919, p. 499.

9. Baker, C. R.: Correct Time for Orthodontic Treatment, J. A. D. A., 12:759 (July) 1925.

10. Chapman, Harold: Internat. J. Orthodontia, 13:144 (Feb.) 1927.

pated, I prefer to start early in the transitional period from the deciduous to the permanent denture, or at about 7 or 8 years of age.

The proliferating power of bone cells, which is such an important factor in orthodontic practice, is much greater in the young patients than in the older ones, and therefore, if we anticipate an extensive alteration in the dental arches, supporting structures or the contiguous tissues, it is highly desirable that treatment be undertaken at an early age.

It has frequently been noticed that the organ of hearing is affected by the pathologic conditions and altered development to which we have been referring. The exchange of air to the middle ear is largely dependent on normal breathing. The ear drum is constructed so as to have an equalized pressure from within and without. With the mouth breather, this condition does not obtain. The membrane becomes thickened, the movement of the ossicles impaired, and the result is the beginning of deafness in the child. The close relation of a hypertrophied and infected pharyngeal tonsil to the eustachian tube provides an easy path for infection to the middle ear, with the painful conditions often associated with mouth-breathing and malocclusion of this type.

Persistent mouth-breathing not only influences the development and function of the immediately adjacent tissues but extends to the neck and chest as well, because of the altered mechanics and muscle action in respiration. Rounded shoulders, pigeon breast and prominent shoulder blades are deformities due to these perversions, just as is the alteration of bones of the face or malocclusion of the teeth. A modification of function produces a modification of structure and as these changes are taking place in the osseus and muscular structures, a change is taking place in the mucous membrane lining the respiratory and oral passages, and also the tissues of the lungs. We are confronted with a vicious cycle which should be of deep concern to us all.

Rogers,[11] of Boston, lays much stress on systematic gymnastic exercise of the muscles of the face, neck and thorax in connection with the conditions that we are considering, and it is reasonable to assume that such exercise should be included as a part of our regular routine if we wish to restore all of these altered parts and functions to a state of normalcy.

From the foregoing, it must not be assumed that there is no help for the young woman or young man with a disfiguring malocclusion or pronounced nasal stenosis, for there is. But the orthodontist, at least, must be more cautious with his prognostication, for a complex that has been years in developing can probably never be entirely overcome.

There is one other thought worthy of stressing in connection with orthodontia; for there is a rather deeply rooted misconception not only on the part of the layman but on that of many professional men as well. Orthodontia is popularly considered a science of mechanics. It is true that mechanical principles play an important rôle in our work, but tooth movement involves biologic and physiologic factors, and therefore growth and development with changes of structure. It also demands a knowledge of etiology and diagnosis and the consideration of the human body as a whole, not merely the mouth as a unit. All of these must be understood and considered as concomitant with the mechanics of tooth movement.

11. Rogers, A. P.: Tr. Am. Soc. Orthodontists, 1918.

CONCLUSION

I realize, as I am sure all of you do, that there is much to be said on this subject that has not been brought out in my paper. The deficiency, which may be due to my own lack of exact knowledge, is more largely due to lack of knowledge on the part of our profession and perhaps also of the medical profession regarding our joint field of practice.

We need more knowledge. It may be of interest to you to know that several of the dental schools in the East are pledged to the inauguration of hospital training as a part of the dental curriculum. This training is to consist essentially of study of cases having a joint oral and systemic interest. It will include cases of systemic disease which may induce oral complications, as well as cases in which oral disease seems to have induced systemic complications. While surgical and hygienic operations in the mouth will be included, the course will be chiefly for study and teaching. This work will require the cooperation of both medical and dental instructors, and in their cooperation, it is believed there lies the germ of new developments in research. My paper may therefore be taken not as a statement of a satisfactory condition of knowledge at the present day, but as a plea for the institution of this cooperative study. The hospital seems to be an ideal meeting place for our specialties and for the prosecution of such studies.

It must be admitted that we are urgently in need of a keener appreciation of our common problems in the field of health service; we need closer contacts between the professions if we are to bring about greater benefits in health and welfare. Therefore, let us pledge ourselves to an educational program that will bring about these desired results, for ourselves and for those whom we serve.

HEREDITY AND ENVIRONMENT*

By MERLE C. COULTER, Chicago, Ill.

THOSE details of heredity in man in which the orthodontist may be interested cannot be given him by an outsider. How a given tooth character or jaw character is inherited, how it may be correlated with other bodily characters and to what extent it may be affected by environmental influence are matters that can be determined accurately only by the orthodontist himself. This requires accurate observation, accurate and systematic recording, thorough cooperation with other orthodontists of the same and other generations and, above all, that freedom from prejudice that is ideally characteristic of the scientific investigator.

The outsider, if he be a geneticist, will know nothing about teeth. He can merely outline the principles of heredity as they have been worked out from experiments with lower organisms, and can suggest what may be expected of the interplay of hereditary and environmen-

*Read before the Chicago Association of Orthodontists, Oct. 31, 1927.

tal forces. Confidently and emphatically, he will assert that the inheritance of tooth and jaw characters in man will be found to follow the very same principles, but he will then, of necessity, leave it to the orthodontist to do the finding.

It is a familiar fact that the characteristics of parents reappear in their offspring. We recognize this to be true not only of man but of all other living organisms as well. One does not hesitate to predict that the egg laid by the barnyard hen will develop into a bird rather than a reptile, and further that this young bird will later assume the characteristics of the hen and rooster that were its parents, rather than those of a jay bird or a pelican. One is equally confident that a grain of corn is destined to produce another corn plant, not an oak tree or a geranium. It is evidently one of Nature's laws for a living organism to produce young of its own species.

Granting, then, that the "general" characteristics of a living organism are regularly passed on from parent to offspring, is this regularly the case for *all* characteristics? Although man always begets man, may not two brunet parents occasionally have a blonde child? May not the egg which develops into the barnyard fowl sometimes produce one of which the plumage color or pattern differs from that of both parents? Is it no true that a few white grains may appear on a corn plant that was grown from a red seed? Experience answers these questions in the affirmative; so that the previous conclusion must be revised by the proposition that occasionally offspring differ from parents in a few of their characteristics.

This is the two-fold problem which confronts the student of heredity: to account for the regular transmission of similarities from parent to offspring, and to account for the occasional transmission of dissimilarities. The first problem can be intelligently approached only through a study of the second. Confronted by the unknown, one can hope to interpret a regularly operating system only through a study of the occasional irregularities.

Artificially, one may induce these so-called irregularities by hybridizing. A pure red-grained type of corn, crossed with a pure white-grained type, yields hybrid offspring all of which are red. The same result is obtained whichever way the cross is made, i.e., whether the red is the female or male parent to the cross. This suggests at once that the contributions of male and female parents are equal.

The white character does not appear in the first generation hybrids. Has it been destroyed, or is it merely being concealed? This question is answered by the second hybrid generation. If the first hybrid generation is inbred, the resulting offspring constitute the second hybid generation. (This inbreeding can be accomplished by self-fertilization in such a bisexual organism as corn.) In the second hybrid generation we obtain a ratio of three red to one white. That this ratio is significant is clear, from the fact that it is always obtained in this experiment. That it is of universal significance becomes clear from the fact that it is obtained with all sorts of characters in all sorts of plants and animals. Evidently the 3:1 ratio is the result of a hidden mechanism of heredity which operates regularly and almost universally. We are tempted to use an hypothesis about this mechanism. One of the original parents was red because it carried within its body "genes" (hereditary units) for redness. We can think

of these genes as being actual material particles, though too small to be visible; and we can think of them as occurring in pairs. Thus, the hereditary formula of the red parent would be RR. Then we may state that the white parent is white because it lacks the genes for redness; the Rs are absent from its body. To keep track of things, we may assign the formula rr to the white parent, employing the small letters for the absences.

The cross between the red parent and the white parent involves a union of gametes (sex cells) from each. When the red parent, RR, produces its gametes, one gene for redness, R, enters into each gamete. Correspondingly, each gamete from the white parent will be of the formula r. Hence, fertilization will bring into the zygote (fertilized egg) both R and r, so that the formula of the resulting individual will be Rr. This is the individual of the first hybrid generation. It is red because it contains the gene, R, for redness. (Evidently one R is enough to produce the maximum redness, so that Rr and RR are alike.)

When this individual, Rr, of the first hybrid generation matures, it will produce eggs of two sorts in equal numbers, R and r. Likewise, since it is a bisexual individual, it will produce sperms of two sorts in equal numbers, R and r. Its self-fertilization will then involve a random mating of its sperms and eggs, so that the laws of chance will preside over the different combinations effected. Obviously, there is equal likelihood for each of the following combinations, so that they will occur in equal frequency: (1) egg R with sperm R, giving RR; (2) egg R with sperm r, giving Rr; (3) egg r with sperm R, giving rR, and (4) egg r with sperm r, giving rr. These are the four types of zygotes that will result from self-fertilization of the red individual of the first hybrid generation; and these four types of individuals, in equal frequency, will comprise the second hybrid generation. (1), (2) and (3) will be red, since each possesses one or more genes for redness; (4) will be white. The 3:1 ratio is thus accounted for.

This hypothesis is a slightly modernized and abbreviated form of one devised by Gregor Mendel in 1865. Like other working hypotheses, it must be tested rigorously, and if it is confirmed by such testing, we will accept it as one of our scientific theories. Numerous tests of this hypothesis have, in fact, been carried out. Two of them will be outlined here.

Under the terms of the hypothesis, a definite result can be predicted for the cross between the hybrid red type, Rr, and the white, rr. The red parent must produce two types of gametes in equal numbers, R and r. The white parent may produce just as many gametes, but they will be of the one type, r. Hence, two possible combinations in equal frequency will result, Rr and rr, and the offspring of this cross will appear in the ratio 1 red (Rr): 1 white (rr). This cross has been made and this result obtained so many thousands of times as to provide unquestionable confirmation of Mendel's hypothesis.

Quite a different type of confirmation is provided by the cytologist. Years ago, the microscope revealed to us that the bodies of living organisms are composed of cells. Later, the perfection of the microscope made possible an analysis of cells, and revealed within their nuclei those darkly staining bodies that we call chromosomes. It is well known that every cell in the body of a given plant or animal contains exactly the same

number of chromosomes, though this number may be quite different in another species. The chromosome number is an even one, and, consistently with this, some stages reveal an association of chromosomes in pairs. With a few exceptions, the two components of every pair are identical in appearance, though frequently quite distinguishable from those of other pairs.

The machinery of mitotic division maintains this constant chromosome number throughout the body of the individual. When, during the development of the body, one cell divides to form two, the chromosomes assume a sort of single file arrangement. Almost simultaneously, every one is split into identical halves, creating a double file of half chromosomes. The two files are separated, and each of the two resulting groups is organized into a daughter nucleus. A wall comes to divide the old cell, and enlargement of parts soon results in two daughter cells of the same size and constitution as the parent. Yet it is to be noted that the only cell components for which there is provided machinery to bring perfectly orderly and exact division are the chromosomes.

These facts might suggest that the chromosomes are in reality the genes. This idea is discredited by the simple fact that there are many more genes than there are chromosomes. Perhaps, then, the visible chromosomes are merely the carriers of the invisible genes, quite a number of genes being located on each chromosome. If, then, the distribution of determiners through the body is effected by these visible carriers, the chromosomes, might we not reasonably expect to see a maneuver on the part of the chromosomes to correspond to the mendelian segregation of genes that occurs during gamete formation?

When microscopic examination is made of those cells from which gametes are produced, it is found that they contain the same number of chromosomes as do the other cells of the body. When these cells commence to divide, the chromosomes behave in a peculiar manner. Coming together in pairs, the entire group now assumes a sort of double file arrangement. No splitting of the individual chromosomes ensues, but the two files of entire chromosomes are separated; so that one member of each chromosome pair joins one group, while the other member of that same pair joins the other group. These two separated groups then become organized into the nuclei of those cells which are to function as gametes. As this performance is the same in the production of both male and female gametes, it follows that every egg and every sperm is endowed with the reduced number of chromosomes. Thus, the so-called reduction division, which always occurs at gamete formation, gives gametes containing just half as many chromosomes as do the body cells. What is most significant is that every gamete possesses one member of each chromosome pair that appeared in the body cells.

This is exactly the mechanism required by Mendel's scheme, on the assumption that the chromosomes are the carriers of the genes. Still more rigorous confirmation is afforded by the fact that the chromosomes have not merely the same mode of distribution as the genes, but have, in fact, exactly the same distribution as the genes; for it is found that occasional irregularities in the distribution of some of the chromosomes bring exactly corresponding irregularities in the distribution of those genes previously assumed to be located on these chromosomes.

The hereditary machinery as we know it, therefore, involves the conception of the invisible genes being carried on the visible chromosomes. Each chromosome carries a single line of genes, and, by special means, we are often able to discover the relative position and distance apart of these genes in the line. As yet, we have not been able to see a gene or to learn of its physicochemical nature.

One of the most important things that Mendel taught us was that hereditary characters ("unit characters," as he called them) are inherited independently. Red corn crossed with white gives red in the first hybrid generation, and 3 red: 1 white in the second hybrid generation. Starchy corn crossed with sweet gives starchy in the first hybrid generation, and 3 starchy: 1 sweet in the second. What, then, will be the result of the dihybrid cross, red starchy with white sweet? Our understanding of the hereditary mechanism tells us that, in such a case, Nature does essentially what man does every time he multiplies. If we multiply or combine the two monohybrid results in the first hybrid generation, red and starchy, we get red, starchy. This is, of course, the result always obtained from the cross indicated above. Similarly, we can multiply together the two monohybrid results obtained in the second hybrid generation, (3 red: 1 white) x (3 starchy: 1 sweet) equals 9 red, starchy: 3 white, starchy: 3 red, sweet: 1 white, sweet. This is the result actually obtained in the dihybrid cross. It is exactly what we would expect if the gene for red is carried on one chromosome pair and the gene for starchy on another chromosome pair, for the components of the different chromosome pairs are distributed independently at the reduction division. Of course, when both genes in question are carried on the same chromosome pair, we get a very different breeding result, but one which is quite in keeping with our expectations.

Two qualifications must be noted to the scheme of heredity sketched above. One lies in the fact that a single dose of a gene often produces less effect than a double dose. For example, RR produces red flower in the four-o-clock; Rr, pink flower, and rr, white. In such cases the method of distribution of the genes is exactly as before.

The other qualification is exactly what would be expected by one who holds the mechanistic concept of life. The salient characteristic of a complicated mechanism is the interaction of its parts. Since the living organism is a complicated mechanism, we would expect that its separate parts or factors would often interact to produce a result which no single factor could produce independently. A race of purple-grained corn, crossed with white-grained, yields all purple in the first hybrid generation, and 9 purple: 7 white in the second. This result is easily understood if we realize that two separate genes or factors must be present simultaneously (must interact) for the production of purple. The original purple parent has both genes, AABB; the original white parent has neither, aabb. Hence, the individual of the first hybrid generation, AaBb, is purple because it has both of the necessary factors. In the second hybrid generation, the same 9:3:3:1 ratio occurs as in the dihybrid (red, starchy) experiment outlined before. Here it is 9 with A and B: 3 with A, without B: 3 without A, with B: 1 without either. Since A and B must both be present to be effective, only the first group (9) will be purple, while all of the others (3 plus 3 plus

1 equals 7) will be white. In many other cases as well, genes operate merely as factors, interacting in various ways to produce expressed characters. This is at once the expectation and the confirmation of the mechanistic concept of life.

Having before us this sketch of the machinery of heredity, let us examine the oft-repeated question, "Which is more important, heredity or environment?" A variety of the primrose is red flowered, owing to the possession of the gene R. The variety without this gene, rr, is white, and the mendelian mechanism operates regularly in crosses. If, now, the RR primroses are grown in the shade, the flowers are as white as though the gene had been absent. An environmental factor, light, is just as necessary for the production of the red color as is the hereditary gene, R. For every character in every organism, a certain heredity and a certain environment are necessary. Hence, the question, "Which is more important, heredity or environment?" is about as sensible as the question "Which leg of a three-legged stool is most important?"

At times, the effective environmental factors are constant, while the hereditary factors are variable. Under those circumstances, such variations as appear in the living organism are due to heredity. Yet to say that here heredity is more important than environment implants a misconception in the mind of the untrained listener, even though there be none in the mind of the speaker. Obviously, one encounters also those cases where heredity is the constant and environment the variable. Whether in any given case of tooth or jaw structure, it is heredity or environment or both that are the significant variables, we must leave the orthodontist to find out.

A final question may be raised as to the origin of the genes. That most if not all known genes have arisen by a process we call "mutation" seems a certainty. Of course, when we use the term mutation, we are covering up our ignorance as to cause. The change seems a random one, and a sudden, spontaneous, intrinsic one, a transformation which has no evident relationship to environmental influence. A gene suddenly appears, a gene suddenly goes, or at least a gene suddenly changes in function. We don't know why, and so we call the phenomenon mutation.

Perhaps the more critical question is whether genes ever originate in the other way. Are they ever acquired during the lifetime of the individual as a result of certain experiences that the individual undergoes, i. e., as a response to environmental influences? In other words, are acquired characters ever inherited?

Without attempting to review the classic evidence on this question, let us merely note that, until recently, the best evidence refuted inheritance of acquired characters. Recent years have provided strong evidence that, in our very simple plants and animals, where the entire body consists of but a single cell, characters which are evidently acquired as a' response to modified environmental conditions may occasionally persist for many generations, and perhaps indefinitely, after the organism has been returned to the original environment. It cannot be said with any assurance that, by this means, a new gene has been produced; for, in these simple organisms, no orthodox genes have been identified, since mendelian inheritance has not been found, nor has there been observed the chromosome

machinery which appears in higher organisms.

Among higher organisms, there have been many recent efforts to demonstrate inheritance of acquired characters. As yet there is only one set of experiments sufficiently accurate and thoroughgoing to be at all convincing. Perhaps the technic employed in these particular experiments serves to "strike at the germ plasm" more effectively than any technic previously devised. By grinding up the eyes of white rabbits, Guyer procured a lens extract, which he injected into the blood stream of fowls. There a reaction occurred which resulted in the production of an antibody, which had the property of rendering functionless the protein of rabbit lens. When serum containing this antibody was injected into the blood stream of adult white rabbits, no noticeable modification occurred. When it was injected into pregnant rabbits, startling results were obtained. Some of the resulting progeny had eyes that were clearly defective. Furthermore, the abnormality was readily transmitted to subsequent generations, without any additional injections being made. What is particularly significant is that the abnormality was transmitted by the male as well as by the female. Nor did the defect decrease in degree, but seemed even more pronounced, in the later generations.

By this interesting procedure, Guyer has produced defective-eyed races of rabbits. Later, he succeeded in accomplishing the same result by more direct means, injecting lens extract directly into the blood stream of pregnant rabbits. The results produced indicate that rabbits can manufacture antibodies for their own lens. Still later, an even more direct method was employed successfully. Eyes of pregnant rabbits were macerated so thoroughly that a certain amount of lens was thrown into the blood stream. Again, defective-eyed offspring were produced. It is interesting to note that this last method is one which might be duplicated by accidents occurring in the natural environment.

Guyer's results have been before the public eye for several years, and as yet have successfully withstood all criticism. Some biologists, clinging to their early convictions, still hesitate to accept this as a demonstration. Some fall back on a definition of inheritance of acquired characters that practically makes the phenomenon impossible by definition, and thereby insult the intelligence of all who have spent any effort discussing the subject. Others agree tentatively that, in this one case, inheritance of acquired characters has been demonstrated in one of our highest organisms.

Could any such phenomenon affect tooth or jaw tissue? I think not. Immunologists tell us that the mammal will manufacture antibodies for only two of its own tissues, lens and spermatozoa. Hence, it seems inconsistent with the best scientific knowledge to believe that, by this or any other means, inheritance of acquired tooth or jaw characters could be effected. Surely, it is practical to advise the orthodontist to disregard this possibility as he would an infinitesimal in a calculation.

DISTURBANCES IN SPEECH*

By B. LEWIS,† Chicago, Ill.

AS regards disturbances in speech, we have to differentiate, above all, the following defects: 1. Stuttering. 2. Stammering. 3. Rhinolalia. 4. Hurried speech. 5. Falsetto voice and the like. 6. Hearing-muteness (audi mutitas).

Let us, first of all, explain the difference between stuttering and stammering. Individuals afflicted with stuttering manifest all kinds of hesitations. They repeat syllables and words. Their efforts in speaking are very often accompanied by co-movements and by spasmodic phenomena. Individuals afflicted with stammering manifest the incapability of properly pronouncing a sound, or they substitute one sound for another, or they leave it out altogether.

STUTTERING

Historically, the treatment of stuttering is very interesting, because it was treated long before the cause was really known. The treatment was kept a secret and sold to doctors and pedagogues. There were innumerable methods; which, of course, indicates how little they really knew about it.

The symptoms are: (1) Clonus, because of the repetition of the consonants, such as p-p-p-p-paint, or l-l-l-l-lamp; (2) tonus, because of staying on one consonant a long time, such as p—paint, or l—lamp; and (3) tonus-clonus, where every repetition is a more severe cramp, such as l-*l*-l-lamp. This defect may only concern certain sounds, and therefore some patients may appear to lisp when they really are ignoring the sound, which they are unable to make. These patients also have spasms in other parts of the body, so-called tics, which may also be cramp-like.

The theories are that stuttering is (1) a cramp; (2) a disturbance in breathing, and (3) a coordination neurosis brought about by a disturbance of the syllable coordination center in the brain.

The Vienna school does not believe these theories because: 1. It is impossible for these cramps to be involuntary, since they come on when the patient wants to speak. 2. Cramps are painful. 3. When the patient makes other movements, he has no cramps. 4. No movement is such that it cannot be imitated by any one else. 5. The patient has one movement today, a different one tomorrow, and then may return to the first. 6. Breathing and stuttering are not equally bad every day. The breathing disturbance is secondary and not primary. 7. It can be proved that the patient has not the syllable in coordination, but a sound.

The Berlin school believes that the psychic element is secondary to stuttering, while the Vienna school believes it a neurosis and the stuttering secondary to

*Read before the Chicago Association of Orthodontists, Nov. 28, 1927.

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it. This point is well proved by a vast amount of statistical material.

As regards stuttering, I do not intend to enter into the many details of the various well-known methods. I wish to mention the excellent Gutzmann method, which is practiced at the Hajek Clinic in Vienna. This method consists chiefly in inspiratory and expiratory exercises, in practicing wave-sounds, combined with physical training. There is also an excellent method by Liebmann, who follows an altogether opposite technic, considering the psychic value. If we strictly individualize them, these methods are very valuable; for what may be profitable for one patient may be without avail for another. It sometimes takes time and much study of the case at hand to determine an adequate method, but by searching patiently, by carefully studying the characteristic phenomena, which vary greatly, we usually arrive at a solution of the problem in due time.

I find it a great help to make use of the ediphone, one of the marvelous creations of that genius, Edison. It is not only that we receive the musical picture in all its details, but the patient himself can get so many beneficial lessons from listening to the transmission of his own voice and can thereby aid much by his sincere cooperation.

Presuming that you are more or less familiar with the treatments in every day use for stutterers, I take the liberty of drawing your attention to a fact which seems particularly important to me, a fact which, as far as I know, has, up to now, not been considered sufficiently: the thorough and energetic training of the muscular vocal apparatus before any actual treatment, whichever we may choose, is started.

It is surely known to you that, as a rule, stutterers are able to sing and to recite without any difficulty, and it is likewise known to you that stutterers are able to speak without the slightest difficulty when whispering. This may easily be explained, for when they sing or recite, their attention is directed to musical sounds; hence, they are distracted from the act of speech; and when they whisper, the activity of the vocal apparatus is altogether excluded; hence, the activity of the muscles.

It is by no means an absolute necessity to be particularly musical in order to perceive the timid, trembling, almost quivering and so often high-pitched sounds in a stutterer's speech.

Although it often happens that the stutterer is not aware of the fact that he is able to speak easily when whispering, he unconsciously approaches more and more the whispered voice in order to find some relief, and hence makes less and less use of his vocal muscles.

What must be the absolute consequence? The vocal muscles grow weaker and weaker, lose their tonus, gradually lag behind in their development and, in the end, become, so-to-speak, incapable of work.

I wish it were possible to demonstrate to you the large number of cases in which a careful, yet energetic, training of the muscular vocal apparatus proved to be a solid foundation. Would you build your home on insecure ground? Why not, then, if possible, first eliminate the torturous phenomena of stuttering and then proceed with the treatment which seems most adapted for the pupil?

The training of the muscular apparatus is by no means as simple a matter as it might appear, for overtreatment, overexertion, might do great harm. We have to be constantly on the watch in order to perceive the sometimes almost in-

audible oscillations which indicate a sudden energetic stop.

Permit me to mention just one of the numerous examples.

Not long ago, I had as a patient a 17-year-old girl whose cracking, quivering voice revealed immediately an altogether undeveloped muscular vocal apparatus. The physician, a well-known laryngologist of this city, who was kind enough to examine the patient for me, stated that the girl's vocal apparatus had the development of a 7-year-old child, in other words, was an infantile type. The young girl had received her education in a fashionable school where children are unwisely taught that they are to be seen but not heard; a training that may prove very harmful in cases of stuttering. It took us quite a while to make amends for the past, but we all were more than pleased with the result.

Every age is suited for such training; whether the patient is old or young, it matters not.

I recall another characteristic case which I treated shortly after my arrival in this city. The patient was a boy of 16 (a particularly favorable age for treatment). It took five treatments to so improve his voice that he declared his intention to be an errand boy no longer, but to study, then go to the university and become a physician. In a word, one often aids the individual into a social sphere from which he heretofore has been an outcast, as an economic failure.

Now and then, it happens that we have a poor result, particularly when we have to deal with altogether unintelligent patients without any desire to work, or with cases of neurasthenic or hysteric character. Fortunately, such cases are the exception.

A general point regarding the neurosis factor is that every stutterer has a known weakness some place in the body. Therefore, when he is assailed in this weak point, he tries, by compensation, to protect it. He can get what he is after either by being stronger or the other extreme, weaker. Children are notoriously the ones to take advantage of a known weakness to gain sympathy. For example, when a mother says, "Oh, my poor child stutters," "Aha," says the child, "no school now, for I have a point in my favor."

This element is of utmost importance, and it demands a great deal of patience to get the child out of this frame of mind so that his maximum cooperation may be obtained. This, of course, is one of the many problems that present themselves to one working in this field.

STAMMERING

And now let us consider those cases which are probably of greatest interest to you: the cases of stammering.

We might define a stammerer as anyone who has a speech differing from the normal in that he cannot express a normal sound and does not know what is correct. The most pronounced cases of stammering we find after operative procedures on the palate, particularly cleft palate, and after orthodontic corrections and in cases of short palate. With palate cases, rhinolalia (Näseln) is associated.

The speech of such individuals is, as you know only too well, in many cases incomprehensible. Before entering this subject, I will say that such cases are, as a rule, curable. I say "as a rule," but I *think* "always." Of course, the training up to perfection sometimes takes somewhat longer, but that is all. If we follow the proper procedure slowly and cautiously, I do not see how we can fail.

Grown-up patients it is quite a pleasure to train, particularly if the patient is poor or vain. Poverty and vanity are

marvelous cooperators. If a position depends on improvement it comes quickly, and if vanity or even love is in question, the progress of these apparently doomed individuals is remarkable. Such patients practice day and night to attain perfection, and the results are most pleasing.

It is, of course, different with children, particularly when they have not as yet attended school or when they are altogether unmusical. Here our best cooperators are lollypops.

In spite of marked efforts needed with very young children, we should never postpone the training or accept the oft-repeated adage: "The child will outgrow it." The youngest patient that I ever had was a little girl of 3, and the result was most encouraging.

We must by no means avoid such tasks, for we have to protect children from becoming conscious of their defects. How cruel other children are when they imitate an unfortunate child with a defect, and thus the tragedy in the child's life begins, a tragedy they never forget. It always gives me much satisfaction to correct defects in early years when I consider the suffering, both mental and physical, that can be avoided.

In cases in which orthodontic correction is no longer possible or false teeth are the cause of defective speech, we always find it possible to direct the muscular action in such way as to produce normal sounds.

I shall mention a characteristic case: A Swedish woman, very poor, called on me a short time ago and stated that she was unable to get a position suited to her training, she having studied accounting. Her upper jaw was markedly protruded and her speech incomprehensible. In order to correct the latter, she had undergone two tongue operations (tongue-tie, in my opinion, is of such a rare occurrence that it is scarcely to be considered), one nose and one throat operation. Finally, her condition had been declared mental. Such diagnoses are made all over the world. It took us exactly six treatments to produce what approached normal speech.

In another case with a similar history, the condition of an extremely intelligent and musical 5-year-old boy had been considered quite hopeless. I mention these cases in order to draw your attention to a very important point: not to frighten the patient or the parents unnecessarily. Our first duty is to quiet them. I always smile; then they are astonished, and I say: "Would I smile if I considered your defect serious? Certainly, it can be corrected"—and then they smile too.

And now a few details in regard to this interesting group. What do we understand by stammering? 1. An individual is unable to pronounce a sound correctly. He, for instance, says: "Thith ith a thweet dish," instead of saying: "This is a sweet dihk." 2. An individual substitutes one sound for another. He, for instance, says: "I dannot dome," instead of saying: "I cannot come." 3. An individual leaves out a sound altogether. He, for instance, says: "I annot ow u," instead of saying: "I cannot show you."

The sounds most frequently lacking include the so-called group of sigmatisms. The lacking sounds are s, ts and sh.

We differentiate between two main types of stammering: 1. Universal stammering (in which the patient is not to be understood at all). 2. Partial stammering (in which the patient is unable to pronounce certain sounds, such as in sigmatism). We have *sigmatismus interdentalis, sigmatismus lateralis* (either dexter, sinister or bilateral), *sig-*

matismus nasalis and *sigmatismus stridans.*

Universal stammerers appear to lack intelligence, but this is in fact only a social disturbance. If the case is mental, we have other phenomena besides.

Sigmatismus interdentalis represents the so-called simple lisping. The tongue, being in the central position, is put between the teeth, thus deviating from the normal. The causes may be: a certain clumsiness, tooth anomalies and, sometimes, too long a tongue. Very often, we do not find any pathologic cause at all. The training has to be adapted to the cause. There is always a way to train the muscles in order to overcome the lisping.

Sigmatismus lateralis (either dexter or sinister or bilateral) we call in German *Hölzeln,* which means that the sounds uttered in such disturbance make the impression as if the individual were speaking with a piece of wood in his mouth. The causes may be severe tooth defects or lateral dental or maxillary anomalies by which the exit of air is brought about.

After even complete removal of the anomalies, the speech defects by no means disappear. In such cases, it is, of course, advisable to train the speech after the cleft palate or dental work is accomplished.

As regards the training, we proceed in similar manner as with the cases of *sigmatismus interdentalis,* with the difference that, by suitable exercises, we first transform the condition into a *sigmatismus interdentalis.*

Sigmatismus nasalis is of very rare occurrence. In this defect, the air is blown through the nose when the patient pronounces s and sh. At first, we get the impression that, in such cases, we are dealing with a palatal defect, but we have to deal rather with an insignificant shortening of the soft palate or with severe adenoid vegetations.

These cases of *sigmatismus nasalis* are rapidly cured by simply closing the patient's nose with thumb and index finger and having both rows of teeth placed one on the other; whereby the current of air is concentrated at the center of the lower row. After some practicing, this becomes automatic.

The object in the therapy of *sigmatism* is to attain the correct tongue position. It was formerly thought that an anomaly of the teeth or a malformation of some was the cause, but this was disproved by the fact that the s did not improve after correction.

Sigmatismus stridans is revealed by a hissing sound. We often hear it in people who speak in an affected way. Another defect in this group arises when the tip of the tongue is drawn backward too far from the lower teeth so that the sound s approaches the sh sound.

To enter into the numerous details and possibilities regarding all the other sounds would, I am afraid, lead too far. Should you be interested in the various procedures, I would be only too glad to demonstrate cases to you at the Dispensary of the University of Illinois, School of Medicine.

In complicated cases of stammering, we have to build up very carefully each individual group of muscles without hurrying, in order not to confuse the various muscular actions. One is not allowed to jump from one muscular group into another haphazardly; we have to work out the problem systematically. Here are those cases in which the environment has not aided in the correction of the child's faults when he began to stammer. Some of his associates even regard it as "cute" when a child lisps.

After the child is 6 years old, the impressions are fixed. We must also consider that the speech defect may exist without recognition on the part of the parents.

Unavoidable manipulations should be made by the patient and not by the training specialist. Every patient can be instructed. In children, we should proceed particularly carefully and be sure not to scare them. If, for instance, pressure on the tongue has to be energetically exercised, let the child put his own little finger into his mouth, and, if he should not succeed, let us put pressure playfully on his wrist, and thus we accomplish our purpose. The training should by all means be a pleasant procedure for the child. As I have said, lollypops and toys should aid materially in gaining the confidence of the child.

It is only too well known that neither in Vienna nor in all Europe can be found the skill that the men of your profession exercise in your chosen field. You have the finest artists in orthodontia and oral surgery, and it gives me great pleasure to feel that, by the work I am doing, I can in a measure aid your work by adding the frame to the picture that you create.

RHINOLALIA

And now a few remarks about rhinolalia (Näseln). We classify the condition as follows: *rhinolalia aperta, rhinolalia clausa* and *rhinolalia mixta.*

In *rhinolalia aperta,* we find the palatal muscles paralyzed. This is often the consequence of diphtheria, or of congenital or acquired palatal defects. In this instance, air goes through the nose when it should not. As regards the acquired form, the nasal sound is overcome as soon as the palatal defect is closed. It is different with the congenital or submucous palatal fissure with too short a soft palate. Here, the closure of the nasopharyngeal fissure is excluded; hence, the nasal speech from the very start, a condition continuing even after a perfect operation.

Rhinolalia clausa, which is caused by hyperplasia of the pharyngeal tonsil, indicates the removal of the adenoid vegetations in order to overcome the nasal sound. In exceptional cases, the rhinolalia continues; that is, when the patient intentionally puts the soft palate out of function. Then, the picture of *rhinolalia aperta* arises.

From the standpoint of speech defect, we know that both *rhinolalia clausa* and *rhinolalia aperta* are made possible by the presence of adenoids. But one cannot promise the clearing up of the speech defect after removal of the hypertrophied tissue. Besides, an *aperta* may follow the removal and be substituted for the *clausa,* because the soft palate may have atrophied, become shorter or lost its tone and therefore does not reach the posterior wall.

Rhinolalia mixta explains itself. This is a rare occurrence, but when it occurs, there is an *aperta* on one side and a *clausa* on the other.

The training of the speech specialist concerns those cases if the paralysis of the palatal muscles is due to acquired palatal defects.

The exercises for such a purpose are very taxing. They are the so-called explosive exercises, whereby the current of air through the nose is checked. The palatal muscles soon regain their activity and the voice becomes clear. Here again we have to be very careful in order to prevent harm from too vigorous therapy.

Obturators, which are often employed in cases in which a palatal defect exists, in order to eliminate all the air from going into the nose, I have found not very practical. The main reason for this

is that it is very difficult to make one the proper size. In the majority of instances, they are either too small or too large.

HURRIED SPEECH

About the cases of hurried speech, there is not much to be said. The patient speaks very fast. His speech cannot keep pace with his thoughts. He cuts off his words, omits and repeats, without being aware of it. The cause is an inborn fast speech tempo. Such individuals have no sensory attentiveness, the condition resembling somewhat a sensory aphasia. This type always shows a clonus alone.

In contrast to the treatment of stutterers, whose natural speaking should, in my opinion, not be interfered with, we teach the hurried speaker a very slow, a very quiet and symmetrical speech, as a bandmaster, baton in his hand.

There is only one danger, and that is, failure to diagnose the condition correctly, and consequent treatment of such cases for stuttering. A patient coming to the Dispensary had been considered a stutterer for twenty-three years. Is it a wonder that this man had tears of joy in his eyes when he found how wonderfully he can speak when doing it slowly?

FALSETTO VOICE

And now just a few words about the frequently occurring falsetto voice, which, particularly in man, may turn out quite a hindrance to success, especially as a public speaker, teacher, salesman and the like.

In treating this defect, we have to direct the voice energetically from the very start into the lowest possible pitch, combined with lowest possible inspiration. The inspiration may be noisy, and the pitch even assume the grunting character.

Cases of falsetto voice can be remedied in a comparatively short time, particularly quickly if the pupil is strong and broad-chested.

However, here again we must emphasize this: Let us proceed very carefully. Let us be on the alert every second in order not to overlook those dangerous, sometimes scarcely audible, signals which indicate a sudden stop.

AUDI-MUTITAS

And now we arrive at a group of speech defects which I earnestly desire to impress on you; the group that we classify under "hearing-muteness."

Audi-mutitas is a condition in which a child is unable to speak in spite of hearing and intelligence.

It is the prophylactic side of hearing-muteness which plays a particularly important part. A little later, you will understand why.

We classify the condition as *mutitas physiologica* (up to 15 months), *mutitas physiologica prolongata (audi-mutitas)*, *surdo-mutitas* (deafness and dumbness) and *mutitas idiotica*. *Mutitas physiologica prolongata (audi-mutitas)* is established when a child, in spite of perfect hearing and intelligence, is unable to speak at 20 months.

The parents of hearing but mute children, being consoled by their friends and sometimes even by the family physician, usually delay seeking aid. Consequently, we find hearing-muteness in children at the age of from 2 years up to 7 or even 8.

A tendency to hearing-muteness cannot be established with absolute certainty. Physicians are inclined to believe that it may be influenced by (1) consanguinity of the parents; (2) hereditary afflictions; (3) infectious diseases, and (4) alcoholism of the parents; or (5) the fact that ignorant mothers sometimes administer soporifics to the child.

When questioning the mother of a hearing-mute child as to how she tried to make her child speak, we usually get the answer: "I tried with all my might to make my child repeat, I tried with kindness, with all kinds of tricks, and I tried with harshness, with all kinds of punishments, without the slightest results."

This answer proves that such therapy is altogether wrong. Does not experience teach that by forcing a child to imitate his disinclination increases more and more?

The cause of hearing-muteness is enlightening.

The cerebral tract from the auditory center, that is, the center for sounds, to the motor center of speech is in hearing-mute children not at all or but slightly developed. This stagnation, it is claimed, is caused by the presence of adenoid vegetations, in that the discharge of the blood and lymph from the brain is obstructed. It is probably this stagnation that causes dysfunction in the area between the auditory center and the speech center.

In trying to overcome this condition by force, we make it worse, and, in the end, we see most disastrous consequences. The mentality lags, and children who, with proper treatment, might have become normal become weak-minded and backward, remaining so all their lives.

What we have to do is to help Nature in a very careful, yet energetic way; but we should by no means force her, by no means try to dictate to her.

It would take too much time were I to describe in detail the entire course of training. I want to mention that hearing-mute children have to be trained by means of very strong visual and auditory impressions. The child must not have the slightest notion that he is being observed; if he does, we may lose the battle at the start. We have to move cautiously all the time in order to arouse and maintain the child's interest.

To speak in a gentle, kindly, monotonous manner in such cases is useless; it leads to nothing. Also, we have to interrupt the training immediately when the child manifests the slightest disinterest or fatigue.

Such a training requires much patience and exertion. It is a great responsibility, but we get our reward in hearing the first sounds, the first words, the first sentences of such a child, and in seeing the tears of joy in the mother's eyes.

After this area of dysfunction is broken through, after the child has repeated the first word, it does not take long for him to acquire perfectly normal speech, particularly when the mother cooperates fully and when teachers follow strictly all directions.

The cases of hearing-muteness in children with perfect hearing and perfect intelligence usually require several days or weeks for correction, seldom longer. When once the child's attention is attracted, even though it does not respond in speech, progress is good.

As an example of what may be accomplished in cases in which the hearing is not normal, I recall the case of the 6-year-old child of a physician, who came to me from Texas. As in many similar cases, it was a question whether or not the boy had hearing. He was closely studied by one of your best otologists and found to have some residual hearing, just a remnant. His father was quite skeptical as to just how much could be done for him, for it was apparent that the boy had a nonfunctioning labyrinth and only a questionable amount of residual hearing.

The child's speech consisted of incoherent mutterings. Such a patient is, many times, advised to take up work at an institute for deaf and dumb children.

However, I discovered that, with the remnant of hearing and the intelligence of the child, I could make excellent progress, and so, within a period of three weeks, I succeeded in giving him a fair-sized vocabulary, which he repeated in all of its tonal inflections, and I sent a happy mother back home to carry on the training as I outlined it.

I must not forget to mention the important fact that removal of adenoid vegetations is absolutely contraindicated as long as the hearing-mute child is under speech training. Speech training comes first, and not until the child is able to speak well, or at least fairly well, is operation indicated.

The teacher should never be present at such operations, lest the child be frightened and refuse to continue with the speech training. Children must, above all, love their teachers.

I wish that I could cover all this great country, from North to South, from East to West, searching for the unhappy mothers, for these unlucky little children, and help them all. Perhaps there might be a baby Lincoln or a baby Edison among them; and would that not be worth while?

185 North Wabash Ave.

CAUSES OF FAILURE IN AMALGAM WORK AND HOW TO AVOID THEM*

By DELOS L. HILL, D.D.S., F.A.C.D., Atlanta, Ga.

I WISH it were possible to present some absolutely authentic figures which would lead us to a correct conclusion as to the percentage of amalgam restorations in the total number of dental operations by the dentists of the United States over a given period of time. You will realize that if one attempted to arrive at such a percentage covering the scope of the dental profession in America, most of the conclusions would be based on estimates and, as a consequence, have no scientific value. Necessarily, the percentage of amalgam restorations in the total number of dental operations will vary greatly in different sections of the country. The only tabulation which I have been able to find was made by James Mark Prime,[1] of Omaha, and given to the Chicago Dental Society in 1921. While he stated that most of his information was gained from cities, and presumably a large proportion was in the Middle West where gold foil is so well manipulated by many outstanding dental practitioners, of a total of 28,729 cases reported on, 9,623 were amalgam restorations.

In view of the dental conditions obtaining in that section of the country, if we take into consideration the great working class of people in manufacturing, railroad and mining centers, in

*Read before the Section on Operative Dentistry, Materia Medica and Therapeutics as the Sixty-Ninth Annual Session of the American Dental Association, Detroit, Mich., Oct. 26, 1927.

1. Prime, J. M.: Relative Merits of Our Principal Filling Materials as Shown and Used Today, J. N. D. A., 9:9 (Jan.) 1922.

whose mouths hundreds of thousands of amalgam restorations are made annually, as well as those living in the outlying districts of our country, it will be found, I am constrained to believe, that at least 50 per cent of the dental restorations are made with amalgam. It behooves us, therefore, to take stock of our efforts in this particular line, to ascertain whether we are placing in the mouths of our patients amalgam fillings which will remain nonleaking and stable.

CAVITY PREPARATION

In view of the fact that the immortal work of G. V. Black[2] on cavity preparation has been recognized for so many years by the dental profession, it is almost inconceivable why dental operators will proceed absolutely contrary to such a recognized authority. J. V. Conzett stated some years ago that our failure to follow these principles and the definite technic which they require constituted the greatest single factor in the failure of amalgam fillings. Fortunately for the operator and for the public, the dental educational institutions of this country are laying a great deal more stress on cavity preparations than ever before; which will have a tendency to produce men who fully realize the importance of giving the proper attention to every step of every amalgam restoration.

In view of the fact that Dr. Black's cavity preparation is so well known, it is not necessary to go into the details in reference to amalgam work.

The investigations of William E. Harper,[3] of Chicago, covering a period of seventeen years with the air pressure test for adaptation in laboratory and clinic tests, made by representative amalgam operators throughout the country, demonstrated that more than 90 per cent of the amalgam fillings made in the above-mentioned test would leak as soon as air pressure was applied from within; that 40 per cent of these fillings showed defects large enough to be apparent to the naked eye, and that, since these leaks occurred almost immediately after the fillings were placed, they were the result of operative faults and not of shrinkage and expansion. A good amalgam filling which does not expand or contract after being completed can be made, provided a high grade alloy, properly mixed, inserted while sufficiently plastic and condensed so that there is no excess of mercury in the mass, is used.

The cause of our failure in amalgam work is due to the lack of care in carrying out one or more of the foregoing requirements, provided we have the proper cavity preparation.

AMALGAMATION

If we realize that there is no shrinkage nor expansion in amalgam fillings properly made with copper amalgam, because of the process by which copper amalgam is manufactured, it is reasonable to expect that all shrinkage and expansion in a finished filling are the result of incomplete amalgamation during mixing and that this shrinkage or expansion can be overcome by sufficiently complete amalgamation during mixing. No movement can take place in a finished filling if amalgamation is made complete in the mortar, and, if we have no secondary amalgamation, we can have no secondary expansion or shrinkage in the complete filling sufficient to disturb adaptation.

Mixing in a mortar requires from two to three minutes, depending on the amount of the mix. The same mix can

2. Black, G. V.: The Physical Properties of Silver, Tin, Amalgam.

3. Harper, W. E.: Amalgam: Its Working Peculiarities and Its Operating Demands, J. A. D. A., 13:1119 (Aug.), 1926.

be made in one of the electric amalgamators in from one-half to one minute, and as the future action of the finished filling depends, to a large extent, on the proper mix, careful attention should be given to it.

Although the difference between a workable and an adaptable plasticity has heretofore been stressed by Harper in his work along this line, I do not hesitate to again call your attention to this important point. While a quick-setting alloy is workably plastic for from five to six minutes, it is adaptably plastic for a very much shorter time—say from two to three minutes—and if an operator is unable to place the amalgam properly in that length of time, he should use a medium-setting alloy or mix a quick-setting alloy so as to be more plastic. Of course, the excess mercury, which is necessary to make a more plastic mass, will be readily removed by a correct technic of condensation. While we may make amalgam fillings to perfect anatomic form—fillings which will stand up under the stress applied to them—using amalgam while it is still in a state of workable plasticity, there is no doubt that if we expect to make a nonleaking filling, we must confine ourselves to amalgam in a state of adaptable plasticity.

VOLUME CHANGES

Up to less than two decades ago, it was generally understood and accepted by the dental profession that all amalgam would either contract or expand on setting. It was one of the efforts of the manufacturers of alloy for dental purposes to control this secondary amalgamation or the volume changes which would take place after the restoration had been placed.

Of course, we recognize that the first amalgamation of silver and tin with mercury, in the mortar or amalgamator, is accompanied by a contraction of the mass; and it was stated by McBain and Knight[4] at the Sixtieth International Dental Congress, London, 1914, that every case occurring in dental practice must be intermediate between no volume change and the extreme changes indicated in the table exhibiting the results of their calculations, which implied that an amalgam tooth filling always contracts. This was contrary to general observations of those who had studied dental amalgam during hardening, which depended on the composition or physical treatment, or both. While we are not interested from a practical standpoint in the contraction of the amalgam mass before it is inserted in the cavity, we are vitally interested in overcoming any changes which may take place in this mass after it is placed in the cavity, and I am constrained to believe that Harper has done more to raise the standard of amalgam fillings than any man in our midst.

ABSOLUTE ADAPTABILITY

If we expect to make satisfactory amalgam restorations—restorations which will remain satisfactory—the amalgam must be in absolute adaptation to the cavity walls, and this can be attained only by working the amalgam very gently, while it is very plastic, to the walls of the cavity. No pressure should be exerted in this procedure. It will have the same effect as jarring very plastic amalgam, with which we are all familiar in the making of amalgam dies. After this adaptation is made, it is condensed with less plastic alloy, with an orderly applied force sufficient to express

4. McBain, J. W., and Knight, W. A.: Report on the Chemical Constitution and Physico-Chemical Properties of Dental Amalgam.

the excess of mercury, which adapts the amalgam to the cavity walls with pressure contact.

CONDENSATION

If we wish to express the excess mercury from amalgam and thereby prevent a secondary amalgamation, which is fatal to amalgam restorations, we can do so only by an orderly applied force sufficient to bring this mercury to the surface. It has developed that at least 10 pounds pressure, applied in an orderly manner, is necessary to be sure of the expulsion of the excess mercury together with such unattached tin as may be present, and to insure pressure contact with the cavity walls. Investigation along this line shows that, in a limited area, more than 50 per cent of the average dental practitioners use less pressure. While these investigations may not be absolutely accurate, when certain dentists are attempting to condense amalgam with a pressure of 5 or 6 pounds, I am sure that these restorations are doomed to failure.

Packing should be done in an orderly manner, using all the force of the fingers, starting at the center of the filling, gradually working toward the margin and covering the space less than the diameter of the plugger at each pressure point. This will force the excess mercury to the more plastic area, bringing it eventually to the surface, where it will cling to the plugger and can be easily removed.

The failure of this complete condensation and pressure adaptation at the cavity walls is disastrous in its results, looking to the permanency of amalgam restorations.

SUMMARY

If we would produce a stable amalgam restoration, we must give due attention to (1) cavity preparation; (2) use of high grade alloy; (3) proper amalgamation; (4) adaptation of plastic amalgam to the cavity walls, and (5) proper condensation.

I am indebted to W. E. Harper for the basic principles of the technic above referred to, by which I have been able to overcome some of the causes of my failures in amalgam work.

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THE FOUNDING OF THE RHODE ISLAND DENTAL ASSOCIATION*

By LATHAM L. BUCKLAND, D.D.S., Providence, R. I.

Mr. President and Gentlemen of the Rhode Island Dental Association:

THE *foundations* of *this paper*—for obvious reasons to the builder—have been laid in fear and trembling, and it is *not* without embarrassment that the superstructure is presented this evening for your consideration.

As to foundations of a different, and more material character, we could set up and perhaps *maintain a claim* to some knowledge and experience. In *this* case, however, you will please bear in mind, the "survey" is "preliminary" and our *"estimate* and *specifications"* "approximate."

With the exception, perhaps of Civil Engineering, there is *no* other profession, involving so many requirements, in so many directions, and of such varied character, as are first and last demanded of the dentist. Our constructions may not be of a monumental character, like those of a *Stephenson* or a *Robeling.* We may not erect for coming generations stupendous piles of gothic architecture, with reverberating arches of solemn grandeur and consecrated aisles; but in our profession *we may erect* that which is *more enduring* than the pyramids if we discover and promulgate a *new truth.*

We are builders and architects in more than an analogous sense; and should be moreover artists in our conceptions and executions. We have calls of an infinite variety upon our resources, and patience should indeed have her perfect work in every one of us, if we would without superhuman endowments, or at least a deeper *enthusiasm* than is accorded the conventional "tooth carpenter," surmount the difficulties, real and imaginary in ourselves and our calling—steer clear of hidden chances of disaster—and be always prepared for any emergency.

Wherein then shall we lay our foundation?

The most thoroughly educated and "worthy and well qualified" in any vocation—other things being equal—will succeed the best. Here as in Nature will be found the "survival of the fittest." Though the shallow pretender may run well in the start, his worthlessness will sooner or later crop out, and his more intelligent patrons desert him.

Preliminary educational, foundations in these times are too much neglected and *especially,* in most of the arts and sciences and liberal professions in our own country has this *ever been* the case, and is the reason *why we* do *not* take the *lead.*

In the recognition of this, our greatest and most prosperous institutions found

*Editorial note: This paper was read before the Rhode Island Dental Association at the founding of the organization fifty years ago (Oct. 1, 1878). It was deemed by the present officers of sufficient interest to justify its publication.

their chief corner-stone, and from this also, our profession in the founding of Dental Associations and Colleges took its greatest and most glorious new departure.

The *first* if not most essential requisition in the candidate and aspirant for place and honors in our profession is that he shall be both *physically* and *mentally* of the most healthy and vigorous organization. *Secondly,* that he shall possess those peculiar traits which are popularly known as native genius and tact.

"Poeta nascitur, non fit."

And, *thirdly,* that these natural qualifications shall all receive the highest culture afforded in the best and most approved preparatory school or college of Dental Surgery.

In accordance with "the code of ethics" of kindred societies, the acceptable practitioner must be a gentleman, in the full American signification of the term. The foundations of his moral character must not be laid in any doubtful substratum, or rubbish of bad habits; these are all to be removed out of the way till a "healthy tissue" is reached and then for additional security a "riprap" as it were of moral, social and Christian virtues and restraints is to be thrown around such foundation that some untimely wave of adversity invade not and destroy the whole.

The science of medicine seems to have had its foundations of old *in,* and coexistent *with* human ills; but we find little or no scientific advancement except of comparatively modern origin.

Books upon the subject were few and far between, and great secrecy was maintained by the ancient who practiced the art of healing such as it was; and of *dentistry* we find *no* mention, prior to the time of Hippocrates, who about 500 years before Christ, wrote of studies upon the teeth.

In fact about all there is of any value to us in the practice of our *specialty,* has been brought to light and knowledge within the last century.

In reverting to the history of our profession we are struck with the amount and magnitude of the work accomplished since the fathers of modern dentistry in 1839 laid the foundations of the first dental college in the world at Baltimore.

Since that time even, what revolutions have taken place in science, art and politics! "New empires have begun and ended" while yet the retrospect is not extended, so, but some of *our* older contemporaries can review the whole as having transpired in their own time; and they tell us of wrecks and abandoned schemes of earnest but mistaken devotees; and read us lessons full of importance for consideration and heed. For our delight and veneration they hold up many bright and shining lights; a goodly number who have rendered themselves—not only in our profession illustrious; but in the world of science and general literature immortal.

Pardon me if in this category is only mentioned here (a cousin of yours, Mr. President), one who gave to suffering humanity the greatest boon since the dawn of the Christian era, *Dr. Horace Wells,* a dentist of Hartford, Conn., the discoverer of anaesthesia.

We now have ponderous tomes of dental literature and periodicals too numerous to read or purchase.

Dental Colleges and Societies have been organized in every city, almost of any considerable pretensions, and in connection with our medical colleges and universities of Harvard, Michigan, California, Pennsylvania, etc., we have now Dental Departments turning out

annually an increasing number of graduates in dentistry till it comes to pass in these days that it requires *five places* of figures to write the number of our contemporary practitioners in our own country alone. "Upon what meat doth this our Caesar feed that he hath grown so great?"

Is the demand of a great people annually increasing in numbers, and general intelligence, in a time of general scientific discovery and progress, the like of which the history of mankind affords no parallel, sufficient foundation for the development of a dental profession of such proportions?

Who will give us a prognosis of the case; and prescribe if desirable the requisite prophylactic?

Nevertheless medicine and dentistry have hardly attained an approximation in relative standing compared with some of the *other* sciences; and will never be found to be as precise as Physics properly so called, until the properties of organized material and the action of living substance are as definitely and thoroughly understood as the properties of crude and inorganic matter; till then we may expect to hear yet more concerning some of our foundations and of the *"incompatibility of filling material with tooth bone."*

Till then, will our professional world, and cherished theories suffer revolution. The "accepted creed" of yesterday, will be discarded for the "New Departure" of today; which in *its* turn, will tomorrow be joined unto the innumerable company of professional by-gones; and so on down through the century perhaps, so that the observer of another centennial occasion may look back upon us and our time and theories and practice very much as we have upon those of a hundred years ago; and who shall *not say* on improvements and inventions yet more wonderful if possible than any the past century has recorded.

"Every day brings something new," of real or imaginary utility for some purpose, to be tested and accepted or discarded by someone, and the conservative practitioner will "make haste slowly" in discarding the time honored practice till the new shall have been found worthy, by having passed the crucible of experimental demonstration, and the light of scientific investigation.

The failure, on our part, however, in recognition of *present* and *prospective* changes in our system of dental education and *practice,* may place us unawares in the category of the conventional "old fogy."

The microscope and spectroscope with electric light are bringing to our understanding many of the occult ways and reading has failed to keep step with the times.

Thus is the modern student of dental histology brought into more intimate relations with the human tooth and its surrounding tissues, and a clearer understanding of dental statics, than was vouchsafed to our predecessors; so that if we *stumble* where they *fell* it will be because we neglect to avail ourselves of the improved light.

There are, and will be, however, many difficulties, to be met in our associations with the human tooth and its environments.

An infinite variety of causes have wrought constantly varying conditions which we are called upon to treat. Could we be employed and *paid* for preventing these diseases, and abnormal conditions, and could be permitted to prescribe for each family under our care, its mode of living; and from early childhood have the care and responsibility of the condition of our patrons' teeth; then might the dentist reasonably

be expected to obviate many of the necessities now laid upon him, and in time, reverse or modify greatly many hereditary tendencies.

Our practice is not laid altogether in the eternal fitness of things. The "heathen Chinee" from time immemorial has been *away ahead* of his boasting Christian brother—perhaps in other respects also than this—that *his* physician receives a regular weekly or monthly stipend from each family so long as such physician keeps them in health; *such compensation ceasing* on the moment of occurring sickness.

Our suffering fellow citizens of the south have been lately calling for pounds of "cure" where we believe a few ounces of *"prevention"* timely applied would have obviated present deplorable conditions.

How many diseases are there which have not their foundations first or last in uncleanliness?

People generally make clean the hands and face, occasionally; and *some* notable instances there are of the washing of pedal extremities which seem to be *tolerably well authenticated.* But, how generally is the skin suffered to retain its excretions till in part removed with changes of clothing, while all the attention or cleaning the teeth ever get is from contact with other parts of the mouth and from food in mastication.

The ultimate disappearance of the dens sapientia has recently been argued by one writer; but is it not a wonder if such is the tendency that we have any teeth at all at the present day after so many centuries of persistent neglect and abuse, especially when we call to mind the millions of toothless mothers of our race.

It is almost an axiom that *clean teeth will not decay,* and for the converse of this proposition you have but to look in the average mouth of people of external proprieties.

When the human teeth shall be kept clean universally from early childhood, if such a day ever dawns, a large part of "Othello's occupation will be gone," and be found to have taken at last another "new" and final "departure."

We are apprehensive, however, of no such very early dawn, but that we shall continue rendering much service as heretofore, of the nature of funeral obsequies and the last sad offices of the "undertaker."

What proportion of human teeth ever come at all to a dentist except for extraction? Notably a very small proportion and these he sees perhaps one day in a year while the remaining 364 days they remain subject to the care or *general neglect of their owners.*

A popular superstition prevails the common mind that a dentist is one who only *"pulls teeth,"* and except for such a consummation, his services are rarely brought in requisition.

How often we meet people who remark, "Well, Doctor, have you pulled any teeth today?" Or, of some of us, they remark, "Well *he looks* as though *he could pull a tooth."* Now, this semblance of strength—ample to "pull a tooth"—is of no mean order in the list of qualifications for a dentist for success; give one *all this* and *good address* and it will be found like charity to "cover a multitude of professional sins."

The true site for the location of our foundations will generally be found midway between extremes and perhaps the chief good of having in any cause the so-called extremist is to enable us to look for truth *every time* about *via media.*

Truth is what we want, and there is no danger in having an "over-dose." In the *truth* of the old saw that "a little knowledge is a dangerous thing" our colleges of pharmacy and dentistry had their foundations, largely as well as our less modern medical colleges. But how *very* significant is this truth in the *preparation,* and *exhibition* of drugs and medicines for the prevention and cure of human ills, and the making and use of Nitrous Oxide Gas in particular as it has become almost an exception to a general rule that a dentist should practice his specialty without anaesthetics, or a patient have a tooth out—if a lady —without gas. An intimate knowledge of these things on the part of the disciple of Apollo whose best services are called in requisition, is not only *desirable,* but very emphatically *essential.*

The foundations of society are so laid that in our relations we are more or less dependent upon each other. The part of wisdom in us is a recognition of this fact. And, a readiness not only to extend a helping hand but to grasp that of another seems to us eminently the part of wisdom.

The wheels of progress roll on by unity of purpose and action and a free interchange of ideas, while they stop or retrograde with bickering jealousies and strife.

This fact has always been an important corner stone in the foundations of all our great and prosperous institutions; and from this in the founding of Dental Associations our profession took its first and greatest and most glorious "New Departure."

The talismanic inscription on the banner of every dental society has been "Elevate Professional Standing"; and much has thus been accomplished. Through systematic training in our colleges and legislation in a number of the states calculated to close all avenues of entry to the profession and practice of dentistry except through the prescribed door and against all comers except the holders of the requisite ticket of admission, a Dental Graduate's Diploma, or the certificate of a Board of Examiners, of a state dental association.

This is perhaps "all right"; and as it should be, in every State in the Union; and as we grow, as a Society this subject of State legislation will command our serious and careful consideration. By reason of this closing by legislative enactment of some or most of the avenues of entrance to our profession in other states, and the recognized demands for a higher culture in the practitioner, the number of students seeking dental colleges has increased, so that from real or apparent demand the number of colleges devoted to our specialty has increased till there *may be*—if not already—call for associate effort to *keep up the colleges* from falling below a desired professional status. Peradventure competition for patronage and a sordid object of money making may cut down the "requirements," till a dental diploma comes to be of such common and easy acquisition, as to be really of doubtful utility, as evidence of preeminent qualifications, or a guaranty of public confidence.

The books are full of general and specific information concerning the different foundation material for all kinds of artificial dentures in present use; and in operative dentistry we have little or nothing of sufficient interest to warrant taxing your time.

The vulcanite base has practically almost driven from the field all the meallic plates, and without doubt materially degraded this branch of dentistry. In your discussion of any of these random

suggestions it might be interesting and profitable to probe this *"rubber" business* a little further, and ascertain if in the workings of the same and the consequent division of our profession into several distinct specialties, there may not be an insidious leak undermining some of our cherished foundations in dental prosthesis.

The specialist in operative dentistry, without doubt, fills teeth more acceptably to himself and patient—prices being equal—than another turning it may be from a case of anaesthesia and the extraction of a number of "hard customers" or from the mysteries and diet, of wax, plates and vulcanite.

The latter becomes in more or less measure unfitted for the finer and more delicate manipulations, and in his diagnosis may omit some distinctive characteristic, or in his prognosis, be at fault at the time—purely from distracting antecedent occupations.

The Knight of the Forceps or the worker of plaster and vulcanite or the doctor of gold foil may not in his specialty of necessity be a "Doctor of Dental Surgery." But for the full understanding and successful treatment of oral diseases and abnormalities the dentist should in fact be all that the D.M.D. or D.D.S. implies—and then the public will accord the dentist the recognition deserved and avail of his services instead of going as is now generally done, to the physician or general practitioner of medicine.

We do not propose here to lay down any code of rules and regulations for the government of those concerned; and would barely mention in passing that there will always be "exceptions to every rule" and success will crown our efforts in larger measure perhaps as we *remember the exception* than as we mind the rule. We have all matriculated in the school of experience, and must pay tuition to the end of the term, and whether freshmen or seniors we find in this school that we often learn more from failure than from success. As we earn promotion in this school, we become more and more convinced that life is too short to make many failures.

If we were allowed to erect over the entrance gate an embodiment of our ideas for the guidance of those coming and constantly entering behind us, it might run thusly:

> "Where the ways diverge
> and Duty points the
> slow unmoving index
> There follow and make few
> and careful exceptions."

A few words in regard to our young society and we remove the "rubber dam" and give you a rest.

The ceremony of laying the cornerstones in the foundations of our local society has been duly observed, and notice of the same and "record of our intentions to build" has gone into the immortal pages of the daily press and through dental journals.

There is a local tradition of one or more similar attempts having been made, but that from some deficit in material or workmanship, the enterprise failed. In occupying the same site we have found no magnificent ruins, so far, or any remains of any firmer society—no rubbish of any sort to clear away; but a clear field, and fair chance—material of the most approved kind and quality is found in sufficient quantity, in convenient proximity ready for immediate appropriation.

Let us have every member of the profession in good standing in the State on the *Roll of Membership* at as early a day as possible; and through united ef-

fort, add ere long another notable institution to the already long list of our glorious little state.

Finally may we all so lay our foundations here in time as to realize all the possible and enduring beauties of proportion in our superstructure of the great hereafter.

In conclusion—if we have in this rambling dissertation, in some small way interested you, or in any measure stirred your pure minds to a better appreciation, and *love of our chosen calling*—a fundamental element not herein before especially named—*then* shall our efforts have been amply rewarded, and not wholly misapplied the time and thoughtful attention you have given; for which, gentlemen, please accept our thankful consideration.

ENAMEL LAMELLÆ

By CHARLES F. BÖDECKER, D.D.S., F.A.C.D., New York City

THE enamel forms the sole protection of the tooth against the ravages of decay, for if this tissue is once damaged, caries penetrates the dentin rapidly and the tooth is soon destroyed. It is therefore important that we fully comprehend the microscopic structure of the enamel in all its details in order to make further progress in the study of the first stages of dental caries.

Much is still to be learned of the histology and pathology of the enamel. Among other mooted points are the enamel lamellæ, for these probably have an important bearing on the manner of penetration of dental caries from the surface of the tooth into its depths. Their distribution, form and possible function will therefore be discussed at this time. Their origin will be considered later.

Enamel lamellæ were first described by me[1] in two communications in 1905 and 1906, and their presence was corroborated by Gottlieb,[2] Orban[3] and Rygge.[4]

The enamel lamella is a thin leaflike structure, having its origin at the dentino-enamel border and passing outward to the surface of the tooth, where it is usually joined to the enamel cuticle. It is organic in nature, for it retains its

*Read before the Section on Histology, Pathology, Physiology, Bacteriology and Chemistry (Research) at the Sixty-Ninth Annual Session of the American Dental Association, Detroit, Mich., Oct. 26, 1927.

1. Bödecker, C. F.: New Method of Decalcifying Structures Containing Minute Quantities of Organic Matter, with Special Reference to Enamel, Dent. Rev. 19:448 (May) 1905. Enamel of the Teeth Decalcified by the Celloidin Decalcifying Method and Examined with Ultra-Violet Light, ibid., 20:317 (April) 1906.

2. Gottlieb, Bernhard: Researches on the Organic Matter in the Enamel, Vertschr. f. Zahnheilk., 21, No. 1, 1915.

3. Orban, B.: Enamel and Tooth Epidermis, the Enamel Lamellæ and Bundles, Zeitschr. f. Stomatol., 24, No. 2, 1926.

4. Rygge, J.: Formation and Structure of the Enamel, Norsk. Tandlaegefor. Tide., No. 7, 1916.

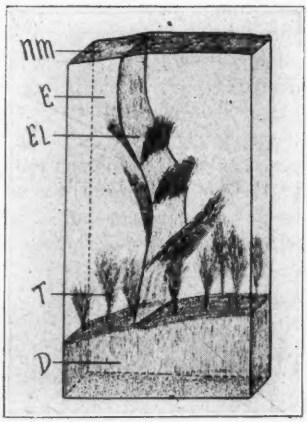

Fig. 1.—Enamel lamella and tufts in a thick section, seen under a binocular dissecting microscope. *D*, dentin; *T*, tufts; *El*, enamel lamella; *E*, enamel; *NM*, Nasmyth's membrane.

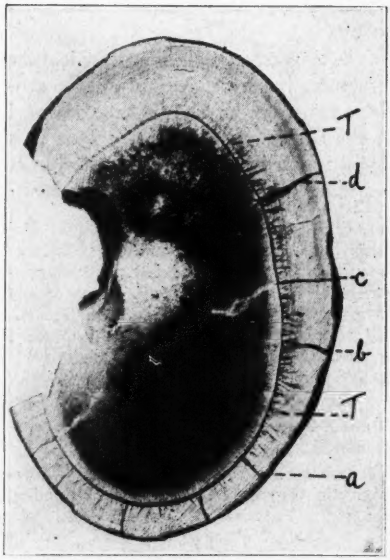

Fig. 2.—A thick ground transverse section of bicuspid showing numerous lamellæ, *a*, *b*, *c* and *d*. *T*, tufts.

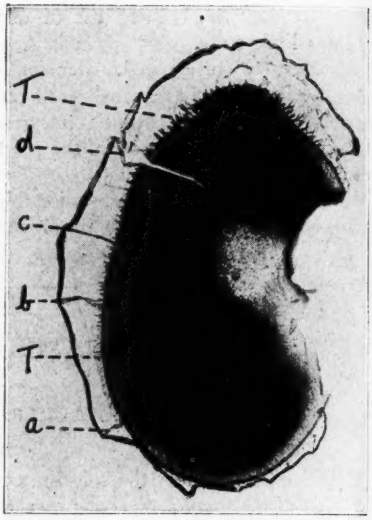

Fig. 3.—Specimen shown in figure 2, decalcified by the acid celloidin method. The enamel cuticle surrounds the specimen and is joined to the dentin by four lamellæ *a*, *b*, *c* and *d*. *T*, tufts.

definite form after the inorganic constituents of the enamel have been removed by an acid during the process of decalcification. The microscopic structure of the lamellæ will be considered later in the description of the illustrations.

The similarity of enamel lamellæ to cracks in the enamel is striking, and it is for this reason that they have previously been disregarded. The method described below clearly shows the difference between lamellæ and cracks in the enamel.

The first intimation of the presence of the enamel lamellæ was received on decalcifying a thin, ground section of a tooth under a coverglass and photographing it with ultraviolet light during the various stages of the dissolution of the enamel. This short-waved light is

not absorbed in the manner of white light by various parts of the specimen, which gives the impression of stained tissue. The lamellæ therefore became visible even in a thin section, as shown in a paper already published.[5] In this illustration we note the lamella as a thin leaflike structure arising from the surface of the dentin, it having been dis-

binocular dissecting microscope. The lamella rises from the dentin (*D*), and passes through the entire thickness of the enamel in an undulating course, sometimes giving off secondary lateral lamellæ and finally being united to Nasmyth's membrane (*NM*) on the surface of the tooth.

The technic employed in preparing

Fig. 4.—A thick ground transverse section of a molar showing lamellæ *a* and *b* and numerous cracks, *x*.

played by the evolution of gases during the process of decalcification.

A diagrammatic sketch of an enamel lamella is shown in Figure 1 *EL*, which represents a part of a thick section of enamel and dentin as seen under a

the specimens shown in Figures 2 to 7 is as follows.[6]

Ground sections of freshly fixed teeth of from 200 to 300 μ are polished on both sides, dehydrated and immersed in

5. Bödecker, C. F.: Nutrition of the Enamel of the Teeth, Dent. Cosmos, 53: 1000 (Sept.) 1911.

6. Further details of this method may be found in Bödecker, C. F.: Dental Histology and Embryology, New York: The Macmillan Company, 1926.

from 10 to 20 c.c. of celloidin decalcifying mixture in a shallow glass staining dish. The decalcifying mixture is prepared by taking 150 c.c. of thick parlodion solution (Dupont) in methyl alcohol (pure) and adding, during constant stirring with a glass rod, the following mixture:

Nitric acid (chemically pure)...10 c.c.
Methyl alcohol (acetone free)...40 c.c.[7]

ter in the enamel, varies in the teeth of different individuals, it is essential for the investigator to select specimens from a number of different persons.

These specimens of enamel, in the process of decalcification, are best examined under a binocular dissecting microscope furnishing an enlargement of from 3 to 6 diameters.

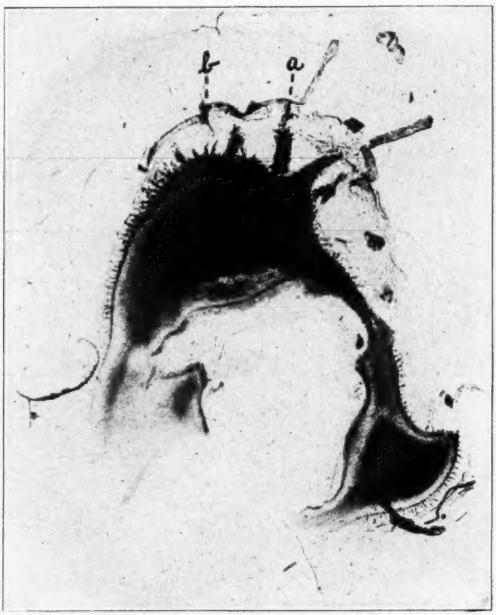

Fig. 5.—Specimen shown in Figure 4, decalcified by the acid celloidin method. *a* and *b* are shown to be lamellæ, while the two *x's* of Figure 4 have disappeared, proving them to be cracks.

Complete decalcification occurs usually in from twenty-four to thirty-six hours. An interesting change in the appearance of the enamel takes place in from two to three hours. As the number of lamellæ, as well as the quantity of organic mat-

The specimens shown in Figures 2-7 were made from comparatively thick sections. We can therefore not expect the clearness usually obtained by photographing specimens of 3 microns, such as shown in Figure 8. The specimens shown in Figures 2-7 are also disfigured by deranged masses of organic enamel

7. A misprint in the foregoing book reads "methyl alcohol, acetone."

matrix, floating in the decalcifying medium.

Figure 2 is a ground transverse section of a bicuspid showing numerous lamellæ. This specimen was decalcified in the above described manner, with the result shown in Figure 3. We clearly see the enamel cuticle extending in an equal distance around the greater part of the specimen, only the lower segment having been displaced and moved up to the surface of the dentin. Enamel lamellæ *a, b, c* and *d* in Figure 2 can be clearly seen again, after decalcification, in Figure 3 *a, b, c* and *d*. The entire enamel appears to be somewhat shrunken, showing a loss in bulk, in Figure 3, but that is quite logical if we consider the high percentage of mineral matter abstracted by the acid during decalcification.

A great number of tufts in the enamel are seen jutting out from the surface of the dentin at *T* in Figures 2 and 3, showing that they are organic structures which persist after decalcification.

Figure 4 is a transverse, ground section of a molar, while Figure 5 shows the decalcified remains of the same. In this, the dislocation of the various elements is considerable, so that only *a* and *b* can be traced in Figure 5. A great number of tufts are again seen fringing the dentin.

The close resemblance of the lamellæ to cracks caused by grinding the specimen has been mentioned. At two places marked *x* in Figure 4, we note lines that look very much like the lamellæ *a* and *b* in this section, yet these structures completely disappear after decalcification, for they are not visible in Figure 5.

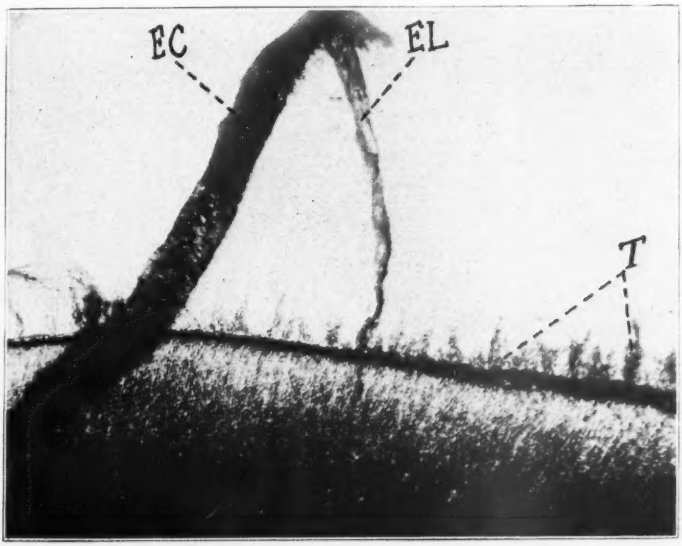

Fig. 6.—A higher magnification of Figure 3 showing lamella *EL* joining the displaced enamel cuticle *EC* to the dentin.

This proves that they had no organic content which could persist after the surrounding enamel had been dissolved by the acid.

A higher magnification of the enamel lamellæ is seen in Figure 6 (taken from Figure 3). The enamel cuticle *EC* had by the time this photomicrograph was taken floated around so as partially to cover the dentin. We clearly see the enamel lamellæ *EL* joining the surface of the dentin with the enamel cuticle.

Figure 7 shows a thick transverse section of a molar after decalcification in acid celloidin. The enamel cuticle completely surrounds the specimen, being seen as a thin line on the right of the specimen, where it has maintained its proper relation to the section. We can clearly discern nine lamellæ, two of which are particularly massive arising from the depth of indentations in the dentin, all being in contact with the enamel cuticle. At the point marked *x*

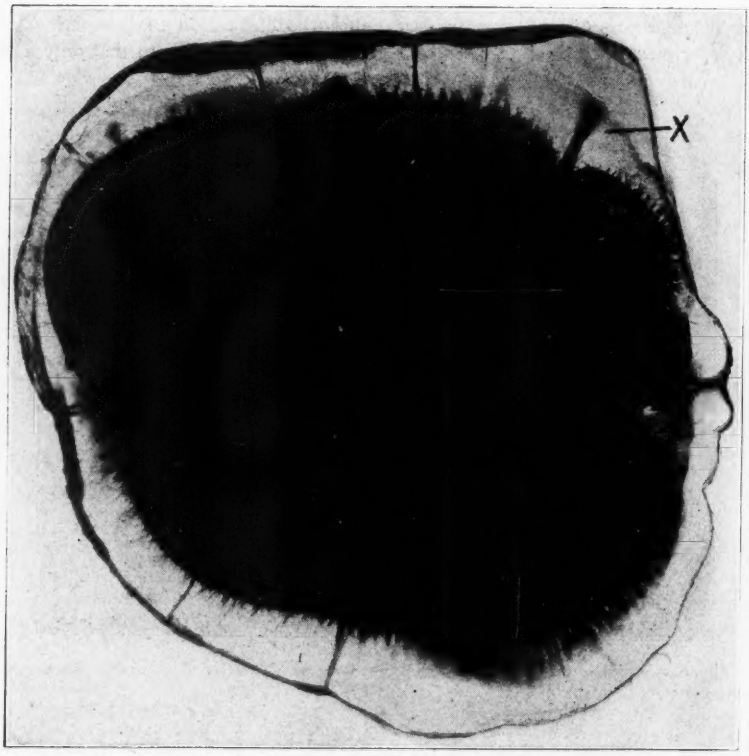

Fig. 7.—Thick decalcified section of a molar having nine lamellæ. At *x*, the enamel cuticle has lifted, disclosing the organic matrix composed of enamel rod sheaths, not visible in detail under this low magnification.

the cuticle has lifted off the enamel, and we can clearly see the delicate organic matrix which is made up of the enamel rod sheaths (these cannot be seen in detail).

The preceding illustrations show the enamel lamellæ to be made up of a continuous band of some organic substance. Little can be discerned as to its microscopic structure. Figure 8 shows more.

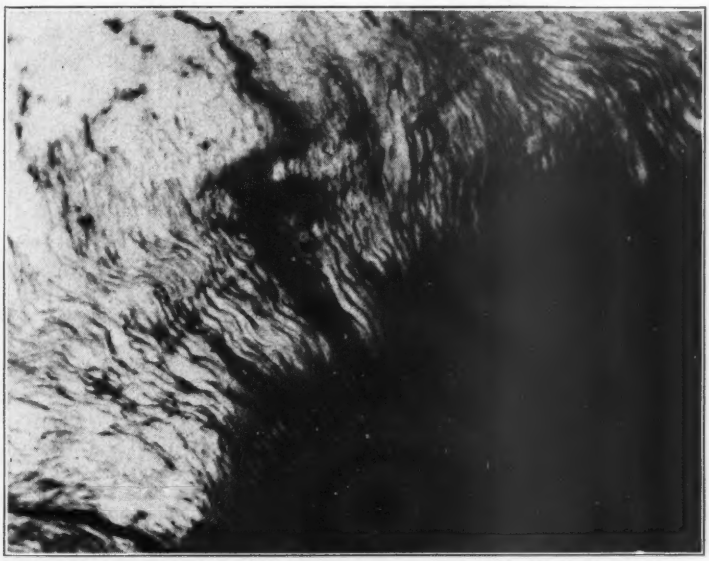

Fig. 8.—High magnification of an exceedingly thin section (3μ) of an organic enamel matrix and a lamella. It is seen that the axial portion of the lamella is a compact mass of organic matter, merging at its margins with the enamel rod sheaths.

It is a photomicrograph of the decalcified enamel matrix of a human adult tooth in which minute details may be noted owing to the exceeding thinness (3μ) of this section. The enamel rods have been dissolved by the action of the acid, showing the enamel rod sheaths in longitudinal and oblique section. The boundaries of the enamel lamella appear to be formed by a thickening of the enamel rod sheaths at the expense of the rods, while the body of the lamella is composed of compact organic matter in which there is no trace of enamel rods.

These structures occur not only in human enamel but also in the teeth of the horse, cow and dog, animals not subject to dental caries. Nevertheless, these structures, I believe, play a rôle in the penetration of dental caries in the human teeth, for their distribution seems to be particularly profuse in those areas most prone to this disease.

Many still do not believe in the presence of the enamel lamellæ and still fewer investigators ascribe any function to these structures. I have maintained[8]

8. Bödecker, C. F.: Permeability of the Enamel in Relation to Stains, J. A. D. A., 10:60 (Jan.) 1923.

that they aid the diffusion of lymph in the enamel, for I was successful in performing laboratory experiments similar to those of Beust[9] in passing stains from the pulp chamber through the dentin into the enamel, clearly staining the lamellæ as well as the enamel matrix.

The experiments of Fish,[10] who placed coloring matter in the vital pulps of dogs' teeth, are striking in this connection. Twenty-four hours later, specimens were ground and it was shown that the stain had been carried by the lymph stream, not only through the dentin but also into the tufts and lamellæ up to the surface of the tooth. Figure 9

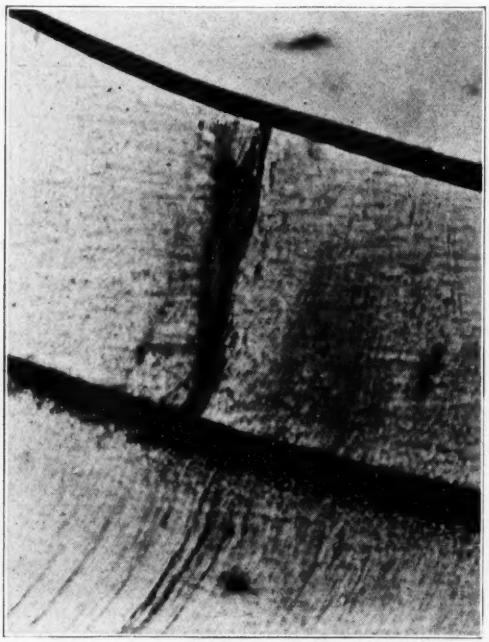

Fig. 9.—Powdered methylene blue placed on carefully exposed pulp of canine tooth of a dog. Specimen prepared twenty-four hours later, showing stain penetration (black) carried only by lymph, through dentin into an enamel lamella and numerous enamel rod sheaths. (Fish.)

As a result of these tests, I came to the conclusion that the enamel rod sheaths are the end organs for lymph diffusion in the enamel.

9. Beust, T. B.: Arch. f. Zahnheilk., No. 4, 1912.

10. Fish, E. W.: Circulation of Lymph in Dentin and Enamel, J. A. D. A. 14:804 (May) 1927. Lymph Supply of the Dentin and Enamel, Dent. Surg., 34:48 (Jan. 22) 1927.

is a photomicrograph kindly lent me by Dr. Fish showing individually stained dentinal tubules passing out from the pulp, the deeply stained dentino-enamel junction (an area containing more organic matter, owing to the branching of the tubules) and a markedly stained enamel lamella. I saw these specimens under the microscope at the Seventh International Dental Congress and the blue coloring (shown as black in the illustration) was clearly visible. Dr. Fish is to be complimented for his valuable investigations as this should prove two points concerning the enamel lamellæ to the unprejudiced mind: (1) enamel lamellæ are present in the teeth during life, and (2) enamel lamellæ are in connection with the current of lymph in the dentin.

CONCLUSIONS

1. Enamel lamellæ are leaflike structures which extend from the dentin to the surface of the enamel and are composed of a continuous sheet of organic matter.

2. In appearance, they are similar to cracks in the enamel. Decalcification in acid celloidin shows the difference.

3. It would appear that the enamel lamellæ offer a ready entrance in human teeth to the bacteria of dental caries. (Gottlieb.)

4. The fact that enamel lamellæ are present in even greater numbers in the teeth of animals which do not suffer from dental caries proves that either the specific bacteria, which, according to studies led by Bunting,[11] Howe,[12] Jay[13] and others appear to be *Bacillus acidophilus,* are absent in the mouths of these animals or that there is still some undiscovered factor influencing this disease.

11. Bunting, R. W.; Nickerson, Gail, and Hard, Dorothy G.: Relation of Bacillus Acidophilus to Dental Caries, Dent. Cosmos, 68:931 (Oct.) 1926.

12. Howe, P. R., and Hatch, Ruth E.: Study of the Microorganisms of Dental Caries, Dent. Cosmos, 59:961 (Oct.) 1917.

13. Jay, Philip, and Voorhees, R. S.: Bacillus Acidophilus and Dental Caries, Dent. Cosmos, 69:977 (Oct.) 1927.

AN AID TO PROGNOSIS IN FULL DENTURE SERVICE: PRELIMINARY DATA*

By WALTER H. WRIGHT, D.D.S., F. A. C. D., Pittsburgh, Pa.

MAN'S ability to guess the future is proportionate to his understanding of past and present phenomena. This ability we call experience. The process of acquiring experience is long and tedious. Methods formulated by observing only one condition usually cause failure when applied to different conditions. Extensive observation of all variations is necessary in order to formulate general principles which may be successfully applied to individual conditions. Too often, our former experiences are forgotten before we meet the same condition again. Carefully prepared written records of conditions, procedure and results are rarely kept, so that the

*Read before the Section on Full Dentures at the Midwinter Clinic of the Chicago Dental Society, Jan. 24, 1928.

day's experiences are hardly remembered when its duties are done.

The United States Weather Bureau is a typical illustration of the value of accurate records. We are prone to smile when the weather-man "misses it," but we would be surprised if we knew how often his prognostication comes true.

The experienced dentist realizes that success or failure is generally of his own making; therefore, he uses every precaution to assure the one and avoid the other. A condition which one dentist regards as impossible of correction may be readily met by another. Experience, equipment, methods and ability vary with each operator; therefore, we have no universal standard by which to judge results. It is evident that, under these circumstances, a prognosis will vary with the experience of the operator. There are some basic requirements, however, without which it is practically impossible to render satisfactory denture service.

Retention, jaw relation, articulation, phonetics, esthetics, anatomic structures and physiologic function are factors beyond the scope of this paper. I suggest that they receive consideration as demanded by the exacting requirements of modern prosthetic work. The causes of denture failure are numerous, and it seems important that we should try to determine, if possible, why the dentist fails to render satisfactory denture service.

For our present purpose, the more important causes of failure may be grouped as follows: 1. Lack of experience. 2. Lack of ability. 3. The presence of anatomic and physiologic abnormalities. 4. Unfavorable changes in the supporting tissues.

Experience comes through observation. It remains by tabulation. The human mind refuses to be burdened with facts which are not kept in circulation. It reminds one of the dentist who stocks his office with every new device but at housecleaning time is compelled to discard some of the most promising innovations so that he will have room to practice dentistry. Observations may soon be forgotten unless they are written into a permanent record. All of the details that are likely to give trouble should, if possible, be detected and provided for in the subsequent restoration. When a dentist begins a denture, he should be able to look into the future and visualize its completion. The more capable he is in this respect, the greater success he is likely to achieve in rendering denture service.

The procedure involved in mouth examination and recording of data may at first seem a burdensome and unnecessary task, but in a short time the busy dentist realizes that the end-result justifies the additional work. The successful business man takes pride in his ability to look into the future. Failure to do so is usually marked with financial loss. The dentist may experience failure without apparent concern. He does not seem to realize that a denture failure is also a financial failure. When the dentist realizes the enormous loss involved in remaking dentures, not to mention the great inconvenience and disappointment experienced by both the patient and himself, he will use every precaution to avoid this undesirable occurrence.

Failure, in brief, is due for the most part to inexperience, inability or carelessness on the part of the operator. In most cases, remaking would be unnecessary if the dentist possessed, at the beginning, the experience which he has acquired by the time the dentures are completed.

UNIVERSITY OF PITTSBURGH - SCHOOL OF DENTISTRY

OFFICE CHART

DEPARTMENT OF CLINICAL PROSTHESIS
DOUBLE DENTURE CHART

NO..... PRECEPTOR

PATIENT
ADDRESS
PHONE
Age
Nationality
Color Hair
Complexion

Teeth Selected { Shade No..... / Mould No..... }

SIZE

	ANTERIORS WIDTH R.—L.	ANTERIORS LENGTH R.—L.	POSTERIORS WIDTH R.—L.	POSTERIORS LENGTH R.—L.
Upper	..... m/m.		.....	..... m/m.
Lower	..... m/m.		.....	..... m/m.

Kind of Former Denture
Years and Kind of Service
Former Denture Wherein Deficient
Mark Teeth Last Extracted — R 8 7 6 5 4 3 2 1 | 1 2 3 4 5 6 7 8 L / R 8 7 6 5 4 3 2 1 | 1 2 3 4 5 6 7 8 L
When Extracted
Mental Attitude — Receptive / Passive / Exacting / Antagonistic
General Health — Robust Average Frail
Saliva — Amount: Normal / Insufficient / Excess; Condition { Mucous / Serous }
Tongue — Length: Med'm / Long / Short; Width: Wide / Narrow; Thickness: Thick / Thin; Muscles: Strong / Weak
Hard and Soft Palate — Large / Avge. / Small; Movable Tissue is..... m/m. from Margin of Hard Palate; Immovable Portion is: Resistant Yielding Flabby
Muscles of Mastication — *Development*: Average / Strong / Weak; *Movement*: Bilateral / Unilateral / Abnormal

STUDY MODELS NO .....

Impressions — Ready to Mount
Mounted — Received by

LINGUAL BAR - CLASPS - GOLD BASE

Impression		
Die - With Wire Measurements		
Clasps or Gold Base { Swaged or Cast }		
Bar Formed - Soldered		
Bar and Clasps Assembled		
Soldered		
Completed		

STUDENT
CLASS
NUMBER
Kind of Denture:

		GRADE	
Preliminary Impression	Upper / Lower		
Trays Conformed			
Final Impression	Compound { Upper / Lower }		
	Plaster { Upper / Lower }		
Relief, Seal, Boxed-in and Painted			
Cast			
Base Plate Construction { Waxed / Flasked—Packed / Vulcanized }			
Denture Bases in Mouth Tested and Approved			
Upper Denture Base and Wax Rim adapted to Patient			
Upper Base Face Bow { Transfer / Mounted / Checked }			
Centric Jaw Relation Recorded Lower Base Mounted—Teeth Selected			
First Series Protrusive Records Articulator Adjusted			
Teeth Arranged for Trial			
Trial Dentures Tested in Mouth { Relation / Jaw Relation / Intermaxillary Space / Occlusions / Esthetics / Phonetics }			
Patient Satisfied with Esthetics			
Second Series Protrusive Records Articulator Readjusted			
Articulation Perfected			
Waxing Finished—Tin Foiled Bases Filled with Artificial Stone			
Flasked Separated Wax Removed			
Trial Closure { Packed ..... / Closed ..... / Opened ..... }			
Vulcanized			
Finished and Polished			
Centric Relation Reestablished Lower Denture Remounted Spot-grinding Centric Occlusion			
Third Series Protrusive Records Articulator Adjusted Grinding-in Occlusal Relations			
Instruct. and Return Card No ..... given Patient			
Inserted			

Adjusted	Adjusted	Adjusted	
Adjusted	Adjusted	Adjusted	
Denture Hygiene	Good	Fair	Poor
CASE COMPLETED			

REMARKS:

CREDITED | Points | Date

STUDENT No.....

Fig. 1.—First page of chart, on which condition of patients and steps of procedure are recorded.

Mouth examination, therefore, should be the first consideration in denture work. It would be as foolish to make dentures without a thorough examination of the mouth as it would be to construct a building without examining the ground upon which the foundation was to be placed. Mouth examination cannot be learned in a day. Constant observation of success and failure emphasizes the fact that certain types of mouths demand certain modes of procedure. It is my observation that most dentists deem it unnecessary to examine the mouth unless they have failed, in a previous attempt, to render service. In this cursory examination, the operator usually confines himself to those particular features which caused failure in the first attempt. If the second restoration is satisfactory, these observations are soon forgotten, and, as a rule, the value of this experience is lost to future endeavors.

Mouth examination must be th. ough. It must be carried through with a systematic procedure similar to that employed by the medical specialties and hospitals. It must not be confined exclusively to the mouth, but must include any observations which, directly or remotely, affect the proposed restoration. We must not overlook the fact that there is a direct connection between denture service and the health of the patient, and the dentist is well within his right when he demands a complete statement as to the physical condition of his patient. This information is regarded by other branches of the healing art as fundamental to success, and yet we are prone to overlook it as unessential, even though we know that denture service ultimately depends on the condition of the supporting structures. I will not deny that service is sometimes obtained with restorations which are constructed contrary to these suggestions, but I believe that the failure seen on every hand is too great a price to pay for carelessness. In order to provide a practical solution of this problem, I shall attempt to explain a definite procedure of examination that may be followed by the dentist in his prosthetic work.

It is recommended that a chart be provided on which the data, together with a record of the procedure, may be recorded. The chart may be arranged to suit the requirements of the operator. The patient's name, address and telephone number are recorded first. This brings up the question of sex.

SEX

Men as a rule are interested in affairs which keep their minds away from themselves. Dentures are often regarded as necessary evils recommended by the dentist or physician and required to keep the physical machine going. Service is the important consideration and men insist on its being rendered quickly.

Women are different. The problem of the home permits time for introspection. They realize the fact that their appearance, which has been a very important consideration thus far, will be appreciably impaired unless dentures are carefully made. They, therefore, stress esthetics, and the dentist must not be sparing in his efforts to achieve the best possible appearance for these patients. Women, as a rule, possess more delicate anatomic features, and have a keener observation and a more artistic intuition, which compels the dentist to do his utmost toward the solution of the individual problems which these patients bring to him.

THE PATIENT'S AGE

Little experience is necessary to convince the dentist that age is an important

factor in rendering denture service. Practically no person over 10 or 12 years can boast immunity from dentures, and I have seen partial dentures and obturators constructed for children under 10 years. The two extremes of life, youth and old age, are well represented among full denture patients, but the majority of patients are between these extremes.

Our records show the mean average of denture wearing patients to be about 49 years. This indicates that the majority of our patients must learn to wear dentures after their habits have become fixed. As a rule, they have gone through the initial period of life without any consideration for their teeth. They have been intent on achieving success in life, and having arrived at middle age when teeth are vitally necessary, they are confronted with the problem of having dentures made. Many of these individuals are engaged in active business or vocations and they consider it a hardship to give the time required for first-class denture service. As a result, they often follow the line of least resistance and finally arrive at the office of the conscientious practitioner with an unsatisfactory restoration and a prejudiced opinion of the dental profession.

Youth is the period of adaptability, and it is reasonable to assume that greater success can be expected if the wearer becomes accustomed to dentures when he is under 40 years of age. It has been our experience that children and young people accept dentures as a matter of course and experience no difficulty whatever in learning to wear them. Between the ages of 20 and 30, patients are particularly interested in their appearance. In middle life, they are more concerned with service, since they realize the value of good health. In old age, the most important consideration seems to be comfort.

OCCUPATION

The patient's occupation suggests the necessity of special attention to certain details of construction in order to adapt dentures to his requirements. I recall a patient who desired a lower denture with which he could blow a trumpet. Another patient was profoundly interested in having a denture with which she could sing. The problems of articulation of sound, as in speech, should always be considered, more especially with individuals who are constantly before the public, as speakers or singers. Individuals who are accustomed to hard manual labor require dentures in keeping with their general physical makeup. The restoration should be strongly constructed to withstand the unusual service to which it no doubt will be subjected.

HABITS

Peculiar habits may thwart our best efforts to render denture service. I have in mind an inveterate smoker the tissues of whose mouth were so hardened by the constant use of tobacco that retention of dentures was practically impossible. This condition was accompanied by sensitiveness of the tissues which resulted in pain and soreness when the dentures were worn.

Alcoholism is also detrimental to denture service. I recall a patient for whom several restorations were made, each one apparently answering the requirements of the conditions when first made. However, after they had been worn for several weeks, they lost retention so completely as to be no longer serviceable.

Some patients have the habit of blowing down their upper denture. This habit grows. I have known denture patients who admitted that whether work-

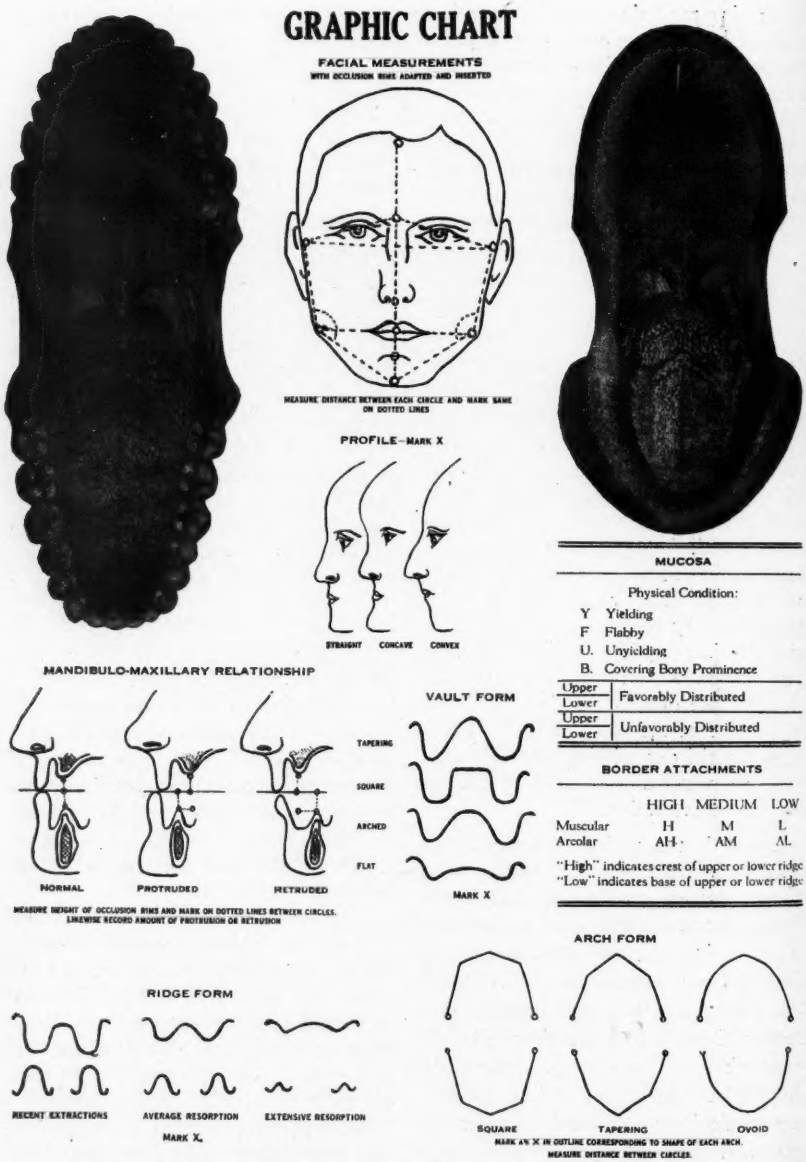

Fig. 2.—Second page of chart, on which conditions and measurements are recorded.

ing or idle they continuously dislodged their upper denture and then reseated it with the tongue. This practice soon leads to loss of retention.

NATIONALITY

Foreign born patients sometimes have peculiar ideas with regard to dentures. In one country, until quite recently, little consideration was given to operative dentistry. This resulted in wholesale extraction of teeth and the making of dentures. Therefore, it is quite common to see individuals under 20 years of age wearing partial or full dentures. It may be quite difficult for the dentist to explain to these patients why decayed teeth should not be extracted and why full dentures should not be made. In another country, it is a common practice among dentists to remove the crown of an offending tooth, allowing the root to remain in place. The partial or full denture is then constructed upon the remaining roots. I have had difficulty in gaining the consent of one such patient to have these roots removed and a full denture constructed according to our ideas. This consideration may not be a momentous one to the practicing dentist, but it is interesting.

COLOR OF HAIR AND COMPLEXION

A space is provided in the record in which the color of the hair and the complexion should be noted. These are considered when selecting the shade of teeth. The fact that they are recorded compels the dentist to observe the conditions present, which should stimulate his interest in the subject of esthetics.

FORMER DENTURES: SERVICE AND DEFICIENCIES

The denture formerly worn is one of the most prolific sources of information available to the dentist. It may be accepted as an axiom that a denture patient does not desire a new denture, except for reserve, if the old one is satisfactory. Unless the dentist approaches this subject with tact, he will find the patient just as loyal to his old denture as he himself is to his old automobile. Regardless of what an individual's own opinion may be, he usually defends the reputation of his old car. So it is with a denture patient. The old denture may be absolutely worthless. Indeed I have seen dentures which were worn on the tip of the patient's tongue and yet, when questioned as to the retention, the patient strenuously affirmed that he never noticed any difficulty in this respect.

There is a way to overcome this obstacle presented by human nature, and to arrive at the real truth of the matter. The dentist should ask the patient which qualities of the old denture he would like to have reproduced and which he would like to avoid in the new denture. This can be done in a confidential manner, which will usually have the desired effect. The patient then notices, possibly for the first time, that his dentures do have some undesirable qualities which should not be incorporated into the new restoration. Above all things, the dentist should never condemn the old dentures, because the very things which he condemns in the old dentures may be the most outstanding characteristic of the new. The patient never forgets. Careful observation of jaw relation, occlusion, intermaxillary space, esthetics, phonetics, lengths of service and denture hygiene will provide the dentist with a very adequate idea as to the faults of the old dentures and will provide the information necessary for success with the new ones.

THE TEETH LAST EXTRACTED

It is important that the dentist know when the patient's teeth were extracted.

This gives him an idea as to the progress of resorption and the permanency of the supporting tissues. The dentist should be careful not to attempt a restoration where resorption is likely to occur until he has a definite understanding with the patient as to the probable outcome. In any event, if resorption is anticipated, as, for instance, in immediate denture service, it is well for the dentist to have in writing a statement from the patient to the effect that he understands the condition and that he is willing to assume responsibility for the ultimate outcome.

MENTAL ATTITUDES

A great deal has been said about the patient's mental attitude. Mental attitudes resemble the weather. The disagreeable days are more noticeable. So are disagreeable patients. A number of delightful patients do not neutralize the effect of the one with an antagonistic attitude. There seems to be a general opinion among dentists that patients inherit this type of mental outlook and that it is entirely beyond the control of the dentist. It is our honest opinion that the dentist has much to do with mental attitudes. I can usually explain the antagonism shown by a patient, especially if he presents himself at the office with thirteen sets of failures in his pocket. As a general rule, patients are receptive when they present themselves for their first denture restoration. Whether or not this attitude changes depends a great deal on the dentist. I can truthfully say that I have never seen more than two patients who maintained a disagreeable mental attitude after we had succeeded in rendering denture service.

It is customary to classify mental attitudes as receptive, passive, exacting and antagonistic. I believe that the dentist who has too many antagonistic patients should examine himself to find the cause. The dentist with a cheerful optimistic attitude, coupled with the ability to render service, is well equipped to avoid undesirable mental complications.

HEALTH

The health of the patient is in reality the foundation upon which the success of dentures depends. Mouth tissues are affected by systemic conditions. Anemic conditions are conducive to rapid resorption. Nervous conditions usually foretell uncomfortable service. Dentures are frequently made for individuals who are in poor health, with the thought that this service will be an aid toward their recovery. We must not overlook the fact that, under such conditions, the patient's physical condition may make it impossible for dentures to be worn with any degree of satisfaction.

SALIVA

We have classified saliva according to its amount, which may be normal, insufficient or excessive, and also according to its condition, which may be mucous or serous. Saliva is a variable factor and its condition depends a great deal on nervous reactions. Usually, when the operator examines the patient's mouth or when dentures are first worn, a considerable amount of saliva and mucus may be secreted by the stimulated salivary and mucus glands. This secretion, in time, returns to normal and does not have a detrimental effect on the restoration. Normal saliva is relatively serous in character, and it may become mucus when stimulated. There are a few cases of insufficient saliva, and this destroys the bond necessary for retention of dentures. Such conditions offer a problem which has not at the present time been completely solved.

RECORD DATA

KIND OF ARTICULATOR NUMBER OF ARTICULATOR

Mounting

Extension of Occlusal surface of teeth.....mm. on right, ...mm. on left, below condyle line.
Incisal edges of lower incisors..... mm. from intercondylar line.
Incisal edges of lower incisors..... mm. above mandibular bow of articulator.

RECORD OF CONDYLE INDICATIONS ON ARTICULATOR

PROTRUSIVE RECORDS

	RIGHT CONDYLE	LEFT CONDYLE
FIRST SERIES (OCCLUSION RIMS)		
SECOND SERIES (TRIAL DENTURES)		
THIRD SERIES (FINISHED DENTURES)		

RECORD OF OCCLUSAL RELATIONS OF TEETH IN FINISHED DENTURES

POSITIONAL RELATIONS OF MANDIBLE TO MAXILLAE

		TEETH LIGHTLY OCCLUDED (UNSTRAINED)	UNDER BITING STRESS (STRAINED)
Centric Relation			
RIGHT LATERAL	Right working		
	Left balancing		
LEFT LATERAL	Left working		
	Right balancing		
INCISIVE	Anterior working		
	Posterior balancing		

Fig. 3.—Third page of chart, on which articulator adjustments and occlusal relations are recorded.

TONGUE

In mouths with natural teeth, the tongue is confined within the limits of the lingual surface of the lower teeth, where it performs the duties of speech and swallowing. When the lower teeth are lost for a considerable period of time, the tongue flattens out laterally and

actually covers the crest of the lower posterior ridge. Naturally, when dentures are inserted, the tongue is crowded into a more limited space, and the patient may experience some difficulty until the tongue has adapted itself to this condition. The lower denture may be dislodged by its action, and the function of speech may be somewhat impaired during this period.

MUSCLES AND MASTICATION

The operator should determine the nature and movements of the muscles of mastication during examination of the mouth. Their condition will usually be related to the physical nature of the individual. Robust individuals will possess a strong musculature; which informs the dentist that the dentures will be subjected to great muscular force and that they must be constructed to withstand this type of service. The patient should be instructed to move the jaw from side to side and forward. During this movement, the operator notices carefully whether or not the patient has unrestricted movement into the lateral and the incisal position. The relation of the rami of the mandible to the tuberosities of the upper jaw should be noted at this time to avoid the complications which sometimes arise after dentures have been constructed; namely, the rami of the lower jaw strikes the upper denture, normal jaw movement being thus prevented. Sometimes, the patient does not have normal jaw movements. Instead of being bilateral, the movement may be confined to one side. The patient may not be able to protrude the lower jaw properly, and the movement may be so restrained as to constitute an abnormality.

THE PROFILE AND MANDIBULOMAXILLARY RELATIONSHIP

The patient's profile should be noticed because it is usually indicative of anatomic development which affects jaw relation. We usually find normal jaw relation associated with a straight profile. A protruded jaw relation is usually associated with a concave profile; while a retruded jaw relationship usually accompanies a convex profile. Since each of these conditions require a slightly different arrangement of the teeth, it is important that the dentist note these variations in each patient. The profile is also an index to the placement of the upper central incisors.

VAULT FORM

Retention of dentures depends on many conditions: The shape of the vault and ridges must not be overlooked. The square vault with well developed ridges, other conditions being equal, is considered most favorable to retention. With a decrease in the size of the vault and surrounding ridges, retention usually becomes less effective. Although a denture constructed for these conditions may be capable of withstanding a direct pull, when subjected to the side thrusts of mastication, it is more liable to lose its retention.

BORDER ATTACHMENTS

The muscular and areolar tissues surrounding the residual ridges make possible the peripheral valve seal and, subsequently, the retention of dentures. These attachments may be high, medium or low in relation to the crest of the ridge. "High" indicates near the crest of the ridge, and "low" indicates near the base of the ridge. The attachment of tissues near the crest of the ridge precludes the extension of the denture bor-

ders, and this, in turn, may be detrimental to the retention of dentures. High muscle attachments, unless carefully studied and accommodated, will probably cause dislodgement of the denture during function.

THE MUCOSA

The mucosa or investing tissue of the denture-supporting area of the ridges and hard and soft palate should be thoroughly examined and its possible effect be understood before the impression is taken. When an architectural engineer contemplates building a structure, he carefully studies the condition of the ground upon which the building is to be placed. Each piece of ground may possess different qualities. The ground may be sandy, clayey, soft, moist or underlaid with rock. Having discovered the particular quality of the ground in question, he next proceeds to calculate the effect of this ground on the proposed building. Regardless of the conditions present, there is but one ideal to be sought in the finished building; namely, that it shall have stability.

We face a similar situation in denture construction. The denture-supporting area may, for convenience, be compared to the ground upon which a building is to be constructed. Some denture areas are large, some small; some have large ridges and some have flat ridges. The tissue covering these ridges may be soft and flabby or it may be dense and unyielding. These conditions must be considered and calculated, so that, finally, stability can be obtained in the completed denture. This has led to a classification of the physical conditions of the mucosa covering the denture area as follows: yielding, flabby, unyielding, covering bony prominence. In addition to this general classification, these conditions have been further classified into two main groups: those which will be favorable to the retention or stability of the finished denture, and those which are considered unfavorable to retention or stability of the finished denture. As a general rule, it may be stated that yielding, especially flabby, tissues covering the denture area are regarded as unfavorable to stability, while nonyielding tissues covering the entire denture area are regarded as unfavorable to retention.

In this discussion, I have called to your mind the most important conditions with which the dentist comes in contact in his prosthetic work. This, you will agree, has been done not for the purpose of burdening the dentist with a multitude of insignificant details, but for the purpose of analyzing the effect of these conditions on the subsequent restoration. Such a mouth examination has become absolutely necessary in my denture service.

Prognosis becomes increasingly important as one employs a systematic method of mouth examination. I trust that this presentation has been sufficiently complete to provide the foundation for those who desire to use it and yet not so lengthy as to discourage those who are skeptical as to its merit.

PARTIAL DENTURE AND CLASP CONSTRUCTION*

By NORMAN B. NESBETT, D.M.D., Boston, Mass.

THE method to be described briefly in this short paper is one that I, with my associates, have used for the past ten years. It has also had a five-year trial in the public dental clinic of Harvard University.

I have selected, for illustrative purposes, the typical lower lingual bar partial denture, believing that it presents more difficult and peculiar problems than most upper partial appliances.

Most lower partial dentures of the type employed where all teeth posterior to the cuspids or first bicuspids are missing fail because they are not properly based, and we employ the term physiologic basing to distinguish this part of the operation.

By physiologic basing, we mean the construction of the base of a lower partial denture so that when the saddles are seated against the ridges under masticatory stress, the pressure over the whole surface of the ridges will be uniformly distributed and so balanced that the pressure applied will be in direct proportion to the relative density of the underlying soft tissues.

The idea is well understood by many of those who practice rebasing in a scientific manner, just as the technic is practically identical, but the term "rebasing" is open to serious objection. It carries the implication that the process may be optional, that it is not an integral part of the very construction of the appliance; yet why consider a denture completed when it is known that, sooner or later, destruction of tissue may ensue? Why dismiss a patient with the promise of rebasing "when the mouth shrinks?" Why rebase a partial denture in any case, if, by proper physiologic basing before the denture is delivered into the possession of the patient, rebasing in the future can be postponed indefinitely?

The inadequacy of plaster impressions for the proper basing of a lower denture has been realized, and sectional impressions of modeling compound have been advocated by some operators. They argue that, as the denture must function under stress, the taking of an impression under stress, or pressure, will result in the production of a cast that is true to stress conditions.

I fail to see how hand pressure applied to modeling compound, harder than tissue, can produce the desired results. How can hand pressure on the modeling compound be accurately gaged so as not to be excessive, and at the same time simulate the function pressure of mastication itself?

There is no assurance that correct tissue stimulation can be obtained, and traumatic pressure avoided, by basing a denture upon a cast reproducing the ridges after artificial or hand pressure has been applied to them. We must approximate function pressure as nearly as possible, and this can best be done when

*Read before the Chicago Dental Society, Jan. 25, 1928.

the denture has been completed and can be seated in the mouth, with a layer of suitable impression material between the saddles and the ridges, and the normal pressure of mastication itself applied.

The immediate results of physiologic basing are even distribution of the masticatory stresses over a greater area, enabling the ridges to withstand greater pressure, and eliminating trauma and subsequent resorption.

The ultimate result is the development of well formed ridges, due to normal bone stimulation, and, in most cases, the total elimination of the necessity of future and frequent rebasings. This claim, that, with proper application of pressure over the ridges, we can cause bone stimulation to a sufficient degree to keep them in repair and in health, is substantiated by Wolff's law, which was formulated more than 100 years ago, and which reads as follows: "Every change in the form and position of the bones, or of their function, is followed by certain definite changes in their internal architecture, and equally definite secondary alterations of their external conformation in accordance with mathematical laws." To put the matter quite concisely, the external shape of the bone is the result of functional adaptation. The alveolar process is no exception to this rule and the bone is strengthened and thickened at those points where most stress and pressure come upon it, and the adaptive transformation of the inner structure and outer shape of the bones takes place according to altered physiologic demands.

In designing and executing such a case, first consideration is given to the abutments or teeth to be used as anchorage. With this in view, every effort is made to use wide, adequate saddles, and to have those saddles so properly based on the supporting tissues that such tissues will not be traumatized and so accelerate the resorption that is invariably associated with small improperly based saddle support and consequent traumatic pressure.

Believing also that the line contact clasp is the cleanest and safest type of clasp to use, our clasps are invariably made of drawn wire, round or oval, in cross-section, and of a properly alloyed metal that can be heat treated so as to maintain a high life value. These very resilient clasps are connected by means of a cast lingual bar or strap, very light but yet rigid enough to maintain properly the correct relations between one clasped tooth and the other or others. It is our belief that even a slight amount of bending or "spring" in the connecting bars of a partial denture will invariably result in the movement and ultimate loss of the abutment teeth. Such a spring will no doubt retain the appliance for awhile, but only at the expense of the valuable abutment teeth.

In order that we may obtain and maintain correct relations between our abutment teeth, we deem a sectional plaster impression necessary.

The teeth to be used as abutments are packed in the impression with technic amalgam, with parallel dowel pins inserted so as to have them removable in the same plane after the stone model is packed. This is an important point, as it is hardly possible to carry out this technic unless the anchorage teeth can be removed from the cast and replaced and held in their correct relations.

The resulting model, with its opposing teeth mounted in correct relation on an adjustable articulator, gives the operator the following advantages: 1. An accurate picture of the two jaws in correct relation. 2. An accurate and faithful reproduction in metal of each

anchorage tooth, with all sulci, undercuts, variations of tipping or inclination of individual teeth just as they are in the patient's mouth. 3. The operator can design his appliance on such a set of models with the minimum amount of guesswork, because all the factors are present, and because the occlusal stresses can be studied and provided for. 4. Errors in clasp construction, lingual bar assembly and incorrect relationship between clasps and lingual bar can be checked and corrected if necessary in the laboratory. And finally, the case can be completed and the supporting saddles correctly based, without the destruction of the original model.

This model, then, is a study model on which the plan of the appliance is drawn, a construction model on which the clasps and connecting structures are made and tested, and, finally, a record model to be filed away, and is very valuable in a future check-up on the case. The removable teeth on such a model make it easy to adjust any individual clasp to correct tension, and make the repair of such a clasp a simple matter. Furthermore, they simplify the construction of the appliance in ways too numerous to mention.

After the lower lingual bar appliance is constructed and balanced on the model and in the mouth as to clasp tension and occlusion, it is put through the final process of corrective or physiologic basing, so that the mucosa and supporting tissues will take their proper share of the load.

This is done by cutting out material from the under side of the saddles, adding black boxing wax thereto, heating to 135 F. and then allowing the patient to close in centric occlusion, maintaining the pressure until the high spots on the ridges are automatically relieved and the soft tissues properly compressed. The black wax is then replaced with the basic material from which the plate was originally made, and then, and only then, is the patient allowed to wear it.

As has been pointed out, the ridge portions of the cast obtained from the plaster impression are merely superficial registrations of the forms of the ridges under masticatory pressure, not merely because the ridges are covered by a compressible layer of soft tissue, but because of the variations in the thickness and the compressibility of this tissue. It requires but a brief examination to discover areas like "islands" of hard, thinly covered bone, amid areas covered with thicker cushions of more compressible tissue. Our principal reason, therefore, for correctly basing these dentures is to compensate for these variations in a definite manner, so that when the saddles are seated against the ridges, under masticatory stress, the pressure upon each part of the surface will be relative to the compressibility of the tissues at that part.

Consequently, everything depends on the character of the impression material used for basing, and the distribution of the pressure upon the tissues when the impression is being taken. Theoretically, the material employed should have a similar degree of compressibility to the mucosa itself and should become plastic at as low a temperature as possible and yet be firm enough when it is cooled to be handled with perfect safety. Of the various waxes and other impression materials that have been tried and tested, black boxing wax comes nearest to meeting the requirements to which we have alluded.

The amount of basic material to be removed from the ridge surface of the saddles is no less important. The depth to which it is cut away to make room for

the impression wax should be determined by the plasticity of the soft tissues. A mere digital examination of the ridges is often misleading. Often, when it has been surmised that enough has been removed, the basic material of the saddles can be seen through the wax at one or more points after the impression has been taken, showing that the relative yield of different parts of the ridge surface had been miscalculated. Only when the wax impression has a uniformly black surface is there an approximation to equalized condensation.

The ultimate result will be well formed, firm ridges that will withstand masticatory pressure without resorption, obviating, almost invariably, any necessity for frequent rebasing.

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FURTHER OBSERVATIONS OF TEETH INVOLVED IN CHRONIC INFECTION*

By FREDERICK B. MOOREHEAD, M.S., M.D., D.D.S., Chicago, Ill.

MOST of the items under discussion are too well known to justify debate. Prejudice and experience are in juxtaposition; a sort of clinical deadlock. One hears too much generalization and too little of substantiated facts. Prejudice and generalization go hand in hand, but gradually they are being overcome by sanity and proven data. Faddists are eternally arrayed pro and con. Here, as everywhere, revolution seems to rule instead of sober evolution. Throughout the country, there are men who cling tenaciously to the doctrine of saving teeth regardless. On the other hand, there is a doctrinaire execrating every pulpless tooth. Between these two groups, there is a saving grace represented by a sober minded group, who are willing to admit the possible and even probable harm of all forms of infection, but who properly insist on evidence acceptable to modern methods of interpretation. To accept evidence of infection is one thing, but to assume the presence of infection, without adequate evidence, is quite another thing.

After all, teeth are quite important structures, and their retention or removal should be predicated upon basic values and facts. That they can be replaced is not, in itself, any excuse for their removal. In recent years, the refinement of methods of diagnosis and the better understanding of chronic disease have opened up an attack on all tissues in which all forms of chronic infection are usually located. In this attitude, the teeth have naturally come in for a large share, because of their number, function and susceptibility to harm. In all fairness to our faith and belief, we must weigh without prejudice or bigotry the contribution to the well-being of the patient, over against the loss through the removal of teeth.

Here as everywhere, values proved and accepted by competent authority must prevail. It is not a question of

*Read before the Section on Radiology at the Midwinter Clinic of the Chicago Dental Society, Jan. 25, 1928.

opinion or notion of one kind or another, but rather a representative judgment, which comes only through long experience, adequate training and natural talent. Dogma may be accepted in metaphysics, but not in science. While medicine is not an exact science, the election of freedom from proof can be made only by the nearest possible approach to truth. Here, every faculty, inherent and acquired, is challenged. In brief, our thesis demands that competency which discharges every reasonable obligation to medical science and society alike. With this accepted background, we approach the discussion of the interpretation and management of certain characteristic chronic infections, related to the teeth, which may be classified clinically in four groups: (1) root-end granuloma (simple); (2) root cyst; (3) liquefaction necrosis; (4) pyorrhea.

The preoperative diagnosis of any one or all of these is made largely by the roentgen-ray. Ordinarily, one film will furnish the necessary information, but frequently two or three may be required.

Angulation, foreshortening and lengthening, interposition of related bony tissues, aberrent condensation and rarefaction frequently call for added films and added skill, on the part of both the roentgenologist and the clinician. The full interpretation of films is a fine art and one which calls for more than experience gained through routine. One must interpret in the film the general behavior of tissue in disease. The general and special character of the hard tissues in health, as well as in disease, the normal and abnormal anatomic index, are closely related items not readily recognized or understood by the mere roentgen-ray technician.

Stated another way, the problem of a locality can only be understood or appreciated in its relation to the whole. The integrity of medicine is necessarily predicated upon the special and general training of the specialist, and the general and special training of the general practitioner. The specialist, on the one hand, must be highly skilful in his particular field and generally intelligent in problems outside his field. The general practitioner, on the other hand, must be highly skilled in general medicine and intelligent in special fields of practice. There can be no safe division of interests. The interdependence of structure and function is indissoluble. This is not argumentative; it is inexorable.

The problem of teeth, which is no different from any other problem, can be met only by taking into full account the patient as well as his teeth.

Decisions are based quite naturally, then, upon general and local findings, the emphasis being placed on the general rather than the local.

Coming more directly to a brief discussion of the four groups listed above. we are not inclined to enter into any argument on current statements, except possibly to express an opinion in a general way about the pulpless tooth.

We have a feeling that bacteria located around a root-end which produces cellular disturbance are probably capable of harming any tissue, and are likely to be carried through the circulatory fluids to other parts of the body. We are not convinced that incidental bacteria which may be found at the root-ends of pulpless teeth, or even teeth with vital pulps which do not produce any local cellular reaction, are likely to be harmful, either locally or constitutionally.[1]

Such teeth should, naturally enough, be kept under observation and examined by roentgen-ray at regular intervals.

1. Moorehead, F. B.: Dent. Cosmos, *69*: 463 (May) 1927.

CHRONIC INFECTIONS

1. *Root-End Granuloma (Simplex).*—This is a regenerative, not a degenerative, condition. Failure of the granulating process to make satisfactory repair is due to one of several conditions: continued reinfection through the root canal; the presence of foreign body, usually in the form of root-filling material, broken broach, or other root-canal instrument; roughened root-end, etc.

2. *Root Cyst.*—This condition is developed by the presence of epithelial cells directly included in the formation of a simple granuloma.

3. *Liquefaction Necrosis.*—This condition is probably due to dosage or a peculiar property of the bacteria in the field. For one or both of these reasons, there is a failure of protection through the formation of a protecting membrane. There is also a constant liquefaction of both the root end and the surrounding bone; both are honeycombed.

4. *Pyorrhea.*—Arguments, exhaustive in point of words, are widely known on the subject of pyorrhea. It is our belief that the cause is fundamentally circulatory; that local conditions play only a contributory, not a causal, rôle.

In a large measure, the roentgen-ray is the most important agent in diagnosis. After all, the extent and character of bone involvement is paramount and determines largely the character of treatment.

There is little or no argument, apart from the condition of the patient and roentgen-ray evidence, in the premises.

Treatment.—First of all, we shall always treat our patient and not his teeth. The treatment of any tooth, mechanically, therapeutically or surgically, is based on exactly those principles which govern the treatment of a lung, stomach, liver, kidney or other tissue or organ. In other words, it is one thing to remember that people have teeth attached to them, but quite another thing to remember that teeth have people attached to them. The teeth are as intimately related through all the agencies of interdependence as other tissues and organs and bear their related values of function and harm. Upon this premise alone may they be removed or saved.

Pyorrhea presents a greater problem of treatment than any other chronic infection involving the teeth. While local treatment must be thorough, systematic and skilfully executed, it is only a part of the problem. General hygiene, diet, exercise, together with a detailed physical examination, are paramount. The general practitioner of dentistry is usually neither interested nor skilled in modern methods of scaling and polishing the root surfaces. Massage of the gums, together with the proper use of the toothbrush, is essential. It is important to decide relatively early after treatment whether the process is under control. If not, definitely injured teeth had better be removed. Delay in progressive cases subjects the patient to unnecessary harm and results in the loss of alveolar structure necessary for the support of a denture.

The management of the pulpless canal is still an unsolved problem. While much refinement in technic has been developed, as in all highly technical measures throughout the entire field of medicine and surgery, the pulpless canal is successfully treated by a small minority of dentists. The skill of any minority, while it is always respected, is not and probably never will be either a criterion or an argument in defense of the few, as related to the whole.

The tooth involved in a root-end granuloma or liquefaction necrosis may

respond to careful and thorough disinfection and filling of the canal. The root cyst can be treated only by the removal of the cyst. No treatment through the canal will be curative. Granting, then, the reasonable selection of teeth involved in pyorrhea, root-end granuloma and liquefaction necrosis for curative measures, without removal, there remain a large number of teeth which must either be removed or treated surgically by root-end resection. This measure is most happily a means of saving many teeth otherwise doomed to removal.

The principles and technic are so well understood that it becomes unnecessary to enter into any details. Apart from careful selection and reasonable care and judgment in the operation, nothing further need be said.

In a final word, our thesis calls for the practice of principles rather than dogma. While infection must always be viewed with suspicion, if not alarm, and should always be checked early, with the least possible injury to the tissues, the best interests of scientific medicine demand an intelligent survey of all of the evidence in each patient. Not every symptom of disorder in every patient can be rationally related to well-known forms of chronic infection about the jaws and elsewhere. While the majority of multi-rooted teeth involved in chronic infection either of the alveolar process or at the root-end are ultimately doomed to removal, there is no well deserved argument that no effort should be made to save teeth in any case. While the urgent demand of one sick patient may invoke radical measures, and justly so, it does not follow logically that an *ipse dixit* is a reasonable or defensible argument.

DISCUSSION

Herbert A. Potts, Chicago, Ill.: I have long stressed the subject of treatment of the patient rather than treatment of the teeth, be they healthy or diseased. I am convinced that many a patient has been made worse by untimely or mutilating operations on diseased teeth, when, if care and judgment had been exercised, the patient would have been benefited by such operation. I am also just as thoroughly convinced that many perfectly well people have been made ill, some seriously, by operations which were entirely unnecessary. There is another large group of people who have been made seriously ill mentally by the ill-advised counsel of friends, dentists, and physicians who are dogmatic in their remarks and advocate the removal of all so-called dead or crowned teeth, regardless of the fact that the gold shell or jacket-crown may cover a perfectly sound vital pulp. Such advisers are fundamentally only insurance agents, content to receive payment of the first premium, regardless of the condition in which the unfortunate patient is placed. As Dr. Moorehead has said, the patient should have the benefit of the combined skill and knowledge of the internist, dentist and roentgenographer, and this should be the consummation of fundamental knowledge, experience and sound judgment. I must take issue in a measure with Dr. Moorehead regarding some of the root cysts, many of which I have seen about the apices of teeth having vital pulps. They may be excited to growth by infection, but we are accustomed to regard the areas about the apices of vital teeth as sterile. Remembering that some of these cysts, especially the large ones, have people attached to them, I prefer to retain many of the teeth, both vital and pulpless, by means of the Partsch operation, and after the bone has regenerated, resect the apices of the pulpless ones, as suggested by Dr. Moorehead.

LYMPHATICS OF THE DENTAL REGION*

By FREDERICK B. NOYES, B.A., D.D.S., Sc.D., Chicago, Ill.

IT seems needless to spend time explaining and emphasizing the importance of a knowledge of the details of anatomy of the lymphatic system as related to the teeth and the dental region. Any one who has any knowledge of physiology or any experience in surgery will accept the statement that such knowledge is important without argument.

In a paper which was read before the Seventh International Dental Congress,[1] the work in this field, up to that time, was carefully reviewed. For that reason, it will be only briefly sketched here.

In the first decade of this century, the great prevalence of tuberculous involvement of the lymph glands of the neck prompted investigators, especially in Germany, to seek for a lymph drainage from the pulps of the teeth to the submaxillary lymph glands. All of their efforts failed, and this led to the widely accepted belief that there were no lymphatic vessels in the dental pulp and to many other faulty deductions.

In 1909 and 1911, Sweitzer, of Berlin, published the results of his injection using a new technic and demonstrating injected lymphatic vessels in the dental pulp.

In 1915, assisted by Dr. Kaethe W. Dewey, I undertook the investigation of this subject, without any knowledge of Sweitzer's work. The first examination of the literature, revealed his results. The demonstration had already been made, but we decided to continue the work and, first, to repeat the work of Sweitzer. Following his method, we succeeded in demonstrating injected lymphatic vessels in the dental pulp and peridental membrane; which beautifully supported the previous work.

Sweitzer had attempted to inject directly into the dental pulp but had failed. We undertook this problem by drilling into the pulp of the cuspid and first molar, fitting a specially made brass cannula into the hole in the tooth, filling it with Gerota fluid and putting light air pressure on it. The results with ten or more dogs were negative. We had been injecting the blood vessels first with carmin gelatin. Finally, an accident in the blood vessel injection gave us a very imperfect blood injection but a very positive lymphatic injection. In this animal, we were able to follow the blue Gerota fluid through the pulp out of the apical foramen, through the peridental membrane and bone to the infra-orbital canal and the inferior dental canal. The vessels emerged from the infra-orbital foramen, followed the facial artery and were traced to the first lymphatic gland of the submaxillary chain. From the mental foramen, they passed along the

*Read before the Section on Oral Surgery at the Midwinter Clinic of the Chicago Dental Society, Jan. 25, 1928.

1. Noyes, F. B.: Review of work on Lymphatics of Dental Origin, J. A. D. A., 14: 714 (April) 1927.

inferior border of the mandible to the same gland. Afterwards, we were able to repeat the results by making the lymphatic injection first and the blood vessel injection second. When microscopic sections were made, the injecting material was shown to be in the lymph spaces of the gland.

In 1926, E. W. Fish[2] published a paper on the circulation of lymph in the dentin. In this work, Dr. Fish clipped off the crown of the cuspid of a young dog of large breed, exposing the pulp. A hypodermic needle was introduced close to the dentin wall of the pulp and India ink left in the pulp without pressure. The animal was kept alive for half an hour and then killed. The India ink was found to have been carried into the dentinal tubules half way through the dentin. The same procedure was followed, ferrous ammonium citrate being used and the iron precipitated with potassium ferrocyanid. This was found to have passed through the tubules to their anastomoses at the dentino-enamel junction. Dr. Fish concluded that the lymph circulates through the dentinal tubules. Some appearances in our material had suggested to us that the lymph passed into the tubules.

I have wanted for a long time to attack the problem from a new angle and had formulated the plan for the present experiments.

We selected a young collie dog. A piece of brass tubing about the diameter of the cuspid at the margin of the gum was cut off, about 2 inches in length, and one end ground flat. From a rat-tailed file, a trephin was made, of exactly the same diameter as the brass cannula and with the same thickness of wall. The dog was anesthetized, and the enamel was ground off with carborundum stones down to a shoulder at the gum. This shoulder was squared and made to fit the cannula exactly by use of the trephin in the surgical engine. The end of the cannula was sealed to the dentin shoulder by a small amount of hard balsam softened by heat, and then phosphate of copper was placed around the joint to stabilize and support the cannula. In this way, the dentin-covered pulp was left extending into the lumen of the cannula. The cannula was filled with Gerota fluid by means of a fine pipet and rubber tube from the air pressure tank slipped over the cannula. A pressure of 400 mm. of mercury was maintained for ten minutes. The object is, of course, to see whether we can inject the lymphatic vessels from the dental pulp through the dentinal tubules. We have not had time to work out the dissections and cannot say what the results will be.

In this work, Drs. Schour and Ladd have worked with me. Dr. Ladd has used scopolamin morphin and ether for the anaesthetic, and it has been so satisfactorily that I have asked him to write the description of its use.

TWILIGHT AND ETHER ANESTHESIA FOR DOGS

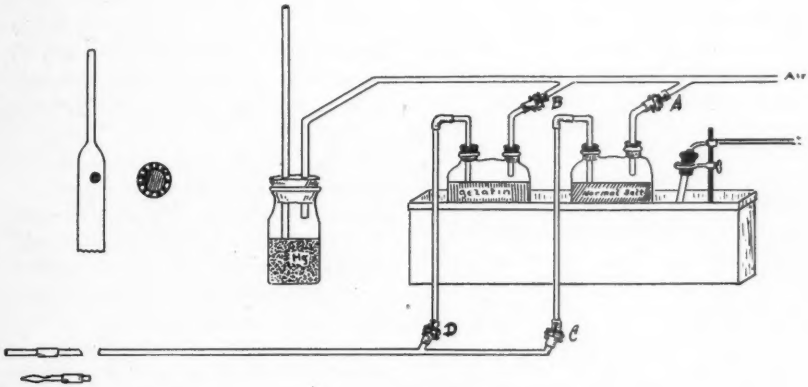
A year-old collie dog weighing about 12 kg., was given a subcutaneous injection of morphin sulphate 2½ grains and scopolamin 1/50. grain. In ten minutes, the dog became drowsy, and at the end of forty-five minutes, he could be aroused but would not stand up. At this time, the injection was repeated in the same manner. At the end of the second forty-five minutes, the dog appeared more drowsy, but could still be aroused, so a third injection was given, repeating the same dosage. At the end of thirty minutes, the dog was in a comatose condition, but there was still muscular rigidity, so about 1 ounce of ether was administered by the drop method. This completely relaxed the dog, and he was strapped to the operating table and occasional small amounts of ether

2. Fish, E. W.: Proc. Roy, Soc. Med., 19: 59-72 (June) 1926.

administered in just sufficient quantities to maintain muscular relaxation.

A very satisfactory anesthetic was obtained in this manner, eliminating the usual struggle at the induction of anesthesia, and such small amounts of ether were needed that one man could perform the experiment and administer the anesthetic at the same time. We do not believe that this is the best dosage of twilight anesthesia to be used, but will have to work that out with further experimentation.

After ten minutes of pressure, the cannula was removed and the blood injection made. For the benefit of those who have not made such injections, I have added a cut of the injecting apparatus. We now have a controlled air tank, but the first apparatus had an air tank made from a 10 gallon can and a tire pump. The bottles containing the physiologic sodium chlorid solution and gelatin mass are placed in a tray of water, kept hot by an electrical water heating unit. By disconnecting the air tube from the gelatin bottle, all air is expelled from the tubes and they are filled with physiologic sodium chlorid solution to the end of the cannula, which is tied into the common carotid artery. The descending vena cava is opened and clamps A, B and C are opened. The sodium chlorid solution is allowed to run until it comes clear from the vena cava. Then clamp C is closed and clamp D opened, and the carmin gelatin passes through the vessels. As soon as it comes strongly from the vena cava, that vessel is tied and the pressure increased so as to distend the vessels. The carotid is then tied, the cannula removed and the head cooled in running water to set the gelatin.



Injecting apparatus used in experiment described.

I am sorry that no results either positive or negative can be reported.

30 North Michigan Avenue.

PORCELAIN BAKED ROOTS IN FIXED BRIDGEWORK*

By C. C. BUDDE, D.D.S., Gettysburg, S. D.

A properly constructed bridge with good fitting abutments makes one of the best types of dental restoration.

No doubt, many of you have had patients who were prejudiced against bridgework. They will say, "No, I don't care to have any more bridges in my mouth. I have one in my mouth now and it is too unsanitary." On examining this bridge, you will notice between the gum and the facing a space wide enough to admit a finger. The facings had been ground on all sides, a rough surface being left to catch the food in mastication. On further questioning of the patient, you find that the bridge had been inserted a short time after extraction. A year had passed, and naturally much absorption had taken place; hence, we have the so-called "cesspool." Under such conditions, is there any reason why patients should be partial to bridgework?

In the foregoing case, if porcelain roots had been resorted to as a means of restoration, the patient would not have been led to believe that bridgework could not be satisfactory.

I do not mean to imply that the plain butted gum facing is not satisfactory, but I do believe that sufficient time should be allowed for the gums to heal, depending on the amount of process being destroyed during the extraction. Unless the teeth have been out for a long time, these facings must be set as tightly against the tissue as possible, without irritating; and, even then, we do not have a glazed surface.

There are a few cases in which the baked root cannot be used very successfully: (1) extensive overbite; (2) very short end-to-end bite; (3) extremely irregular teeth.

In the case of extensive overbite and extremely irregular teeth, it can be used with much difficulty, but in cases of very short end-to-end bite, it is practically impossible on account of lack of room to set the teeth to get the proper contour and esthetics.

In my own practice, I resort to the use of the porcelain baked root whereever possible, and although it is used extensively in the practice of today, I do not believe that it is given the recognition which it merits. I sent a model for a root to be baked to a laboratory in one of the larger cities of this state, and was very much surprised when they told me they did not do that kind of work because there was not enough call for it to pay them to handle it. Perhaps it is because the other type of bridgework can be handled more easily and faster; also, there are very few of us who would go to the expense of installing a porcelain furnace, necessitating sending to the laboratory for baking of the root, which of course causes some delay; but, in the long run, it is not the length of time it

*Read before the South Dakota State Dental Society, Aberdeen, May 14, 1928.

takes to restore these teeth that counts, but the satisfactory service that this bridge will give after it is in the mouth from the standpoint not only of cleanliness, but of esthetics as well.

When a patient presents himself for extraction, we may resort to one of two procedures: In a case in which the lost tooth is to be restored with a porcelain root, we may either extract the tooth first and then go on with our preparations, impression, etc., or we may finish the bridge and insert it immediately after extraction. The first method is more satisfactory in most cases.

In many cases, you will find sensitive or "fussy" patients who would not care to have anyone see them minus a front tooth; hence, you will have to resort to making a bridge before extraction. I seldom follow this procedure for three reasons:

1. In cutting away from the model the tooth which is later to be extracted, it is a matter of guesswork to determine the size and length of the root to be baked, and also the exact direction which that root should run. You cannot tell by the dimensions at the gingival margin the size of that particular root. Some teeth look very large at the gingival margin and taper very abruptly to a very fine point. Some roots are very wide labiolingually but extremely narrow mesiodistally, and vice versa.

2. When the bridge is finished and ready to be inserted, you will usually find that it will not go to place owing to the fact that the root is impinging in some area, usually in the process underneath. It is then necessary to grind away the perfectly smooth surface of the root, thereby destroying one of the advantages of the baked root. Then we are not sure that the root is not bearing too heavily on the bony structure. If the root has to be ground to make it go to place, it should be reglazed.

3. In cases in which the tooth is badly abscessed, it is better to let the socket drain for a few days to be sure that it is free from all pus and infection. The bridge should be inserted as soon as possible and not too much healing allowed. When this method is used, I usually pack the sockets with gauze immediately after extraction and change the packing every day until I have the bridge ready for insertion. The porcelain root should by no means be forced into the socket to make the bridge go to place, as this will cause irritation, often a pronounced swelling, necessitating removal of the bridge. Some operators say that a root should not go too far into the socket; but it will do no harm as long as it is not impinging.

I have been using a method which is more accurate than mere guesswork in determining the inserting of baked roots. I shall take for an example the extraction of an upper central, although the same method can be used regardless of the number of teeth supplied.

The abutments are first prepared, three-fourths crowns on central, and lateral incisors whenever possible. The wax patterns are carved directly by the following method: Take a piece of thin gage copper band about 3 mm. longer than a preparation wide enough to extend around the tooth in order to get a good grip for a pinch band. The gingival surface is trimmed as for a crown. The inside of the band is now oiled and some blue inlay wax is inserted to fill the band. It is now forced over the tooth, the band being held together by flaps and then chilled. Spread the band apart; remove, and carve the wax to form. I found that by making three-fourth crowns by this method, a perfect

fitting crown is assured. After the crowns are in place and finished on the tooth, the central incisor is extracted, and if the tooth is not apically involved, the bite and impression may be taken immediately.

The first step is to soften a piece of modeling compound and roll it cone shape, to about the size of the socket. It is then forced up into the socket, care being taken not to use too much pressure. It is not necessary to force the compound the full length of the socket. The compound should be left knob-shaped on the outside so as to be firmly held in the plaster when the impression is taken.

The impression is now taken, the compound coming loose from the socket and being incorporated in the impression, as in abutments. The impression is now stained and run up in Healy stone or some hard setting material, and allowed to set for four hours. When the model is separated, it is a simple matter to soften the compound stick and remove it, leaving an exact reproduction of the socket in the mouth. By this means, the root can be accurately baked as to the size and direction of the root into the socket, and thus impingement and irritation is avoided.

After the root is in place on the model and the bridge is assembled and invested, we come to one of the most important parts of the construction, the soldering. It is important that the interproximal spaces be left open in order that the gum septum will go to place between the teeth, which gives the gums a natural appearance. The bridge should be soldered close to the incisal side of the abutments and the backing of the tooth supplied, leaving a V-shaped space to accommodate the septum and also leaving a natural, self-cleansing area. The space must be finished smooth to avoid irritation.

In a bridge of this type which has been in place for several years, it is impossible to get away from partial absorption of the gums, from the gingival margin of the tooth, but if the root has been properly constructed, it will scarcely be noticeable.

The results obtained by use of this type of bridgework are very gratifying to the patient as well as to the dentist, and we will be rewarded not only with better fees for our work but also with more satisfied patients.

A PRACTICAL CONTRIBUTION TO THE STANDARDIZATION OF CASTING TECHNIC*

By GEORGE M. HOLLENBACK, D.D.S., Los Angeles, Calif.

THE advent of the casting process undoubtedly marked the greatest single step yet achieved by the dental profession. Its use has become so nearly universal and so commonplace that there is a marked tendency to forget how much we are dependent on it to produce the results which modern dentistry demands. Those in our profession who practiced before 1907 (the year this method was made available) have but to recall the methods then in vogue and to consider the vast difference between the so-called good dentistry of that day and our present standards to fully realize its great importance. The casting process is largely responsible for the fact that we are able to cope with the various problems of restorative dentistry in a manner which, to a considerable degree, meets the requirements of our present-day conception of dentistry as related to physiology, function, mechanics and esthetics. To be more explicit, it has provided means whereby badly broken-down teeth may be restored to normal function and usefulness in a conservative manner, whereas, formerly, we resorted, in many cases, to some type of a banded crown and even to divitalization. It has to a large extent taken the place of amalgam in cavities of large size and difficult access, where gold foil is not practical. It has provided means whereby the construction of abutment pieces of a type which will meet our present requirement is not only possible, but also comparatively easy. (Fig. 1.)

And last but not least, it has enabled us to construct removable pieces of such beauty, serviceableness and mechanical perfection as to be a constant source of inspiration to the operator and a blessing to humanity. In view of the foregoing presentation of facts, who will doubt the accuracy of the statement that the casting process represents the greatest single achievement ever made by our profession?

At this time, let us partially pay our debt by proper display of appreciation for the work of William H. Taggart, who made this process available to humanity. A realization of the fact that almost all that was known of dental casting in 1907, and for many years following, was the result of his individual efforts will give him the place which he so richly deserves, as one of the greatest men our profession has produced. It might well be doubted that our profession has ever produced another man so peculiarly gifted that he could have undertaken this great and baffling problem, and mastered it, as Taggart did, so thoroughly that, for many years, his original instrumentarium and technic stood without a peer,

*Read before the Section on Operative Dentistry at the Midwinter Clinic of the Chicago Dental Society, Jan. 25, 1928.

in spite of the fact that many of our ablest brains were expending unlimited effort to improve on the method. Immediately after Taggart's announcement in 1907, many attempted to share his popularity by means of various innovations and so-called improvements and short-cuts. Most of these had absolutely no merit and have long since been forgotten; others are in use today. One peculiar circumstance which is common to almost all these so-called improvements and innovations is that some single step has been heralded as a "cure-all" or "missing link." To enumerate a few of them: One operator, about ten or twelve years ago, evolved a long-drawn-out and exacting method of repeated annealing of, and addition to, the wax pattern during construction, heralding it as an absolute necessity, the use of which would solve the problem. Another advocated the use of an electrical device for carbonizing the wax and drying the mold, making similar claims, but losing sight of the fact that this is only one of the problems; also, that the means whereby the heat is generated makes not the slightest difference, its control being all-important. Others have advocated quick elimination by the so-called boiling-out method; and so forth and so on, *ad infinitum*.

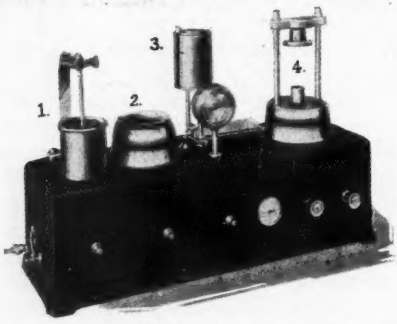


Fig. 1.—Casting apparatus in which all parts are embodied in a single unit. *1*. Mechanical spatulator. *2*. Heater for elimination of wax. *3*. Automatic drying and heating oven. *4*. Air pressure casting machine.

Many of these methods did have some inherent merit; many did not. Some have survived and some have not. But the fact remains that most of the so-called and the real improvements have attacked the problem from one angle only, via some peculiar hobby of the inventor, and have not, as a rule, attacked it as a whole; which is the way it should be done. This is not given in disparagement of these efforts, as most of them have been productive of good, and many of these operators have done very creditable work.

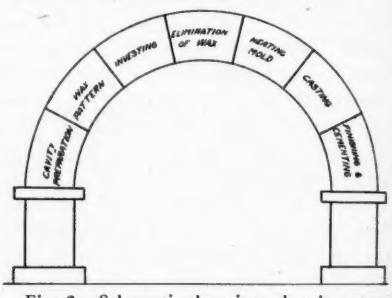


Fig. 2.—Schematic drawing, showing steps in process.

The purpose of this paper is to present a technic wherein the problem has not been attacked from a single angle, or made to coincide with some peculiar hobby of the writer, but is one in which each step has been given due consideration, with a realization that all are equally important, and the degree of success or of failure achieved is in direct ratio to the manner in which each is performed.

Before commencing the description of this technic, it might not be amiss to dis-

cuss briefly the present status of the cast restoration, its indications and contra-indications. The advent of the cast restoration was not an unmixed blessing, not because of its inherent shortcomings, but because of the poor judgment of its users. The inlay should not be used to the exclusion of other filling methods, particularly gold foil, which, to date, undoubtedly occupies first place as a permanent and generally satisfactory filling material. Gold foil is indicated only in

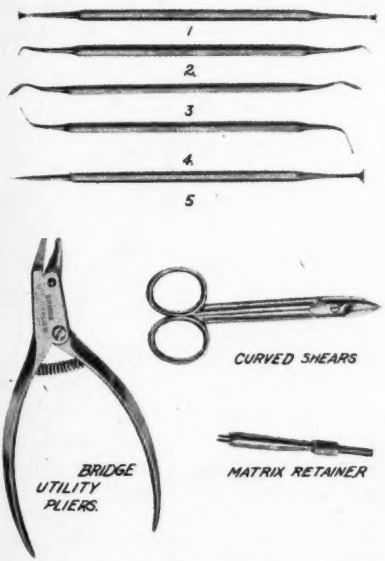


Fig. 3.—Carvers and other instruments required for the proper performance of the technic described in the text.

comparatively small restorations which are fairly easy of access; such as Class 3 and 4 cavities, in the anterior teeth; also, in Class 1 and Class 5 cavities where decay has not progressed too far, and in the smaller Class 2 cavities in molars and bicuspids which are sufficiently easy of access. The cast restoration is indicated in most other locations where esthetics will permit its use. It is particularly indicated in badly broken-down teeth such as were formerly crowned, and, in this class of restoration, it should be the method of first choice. It should be seldom, if ever, used in Class 3 cavities and only occasionally in Class 4 cavities. One of its greatest fields of usefulness is in the construction of abutment pieces of the inlay, partial veneer and full veneer type.

Another class of restoration in which it is particularly advantageous is in the building up of badly broken-down anterior teeth; the type of case in which, ordinarily, a porcelain jacket would be used. The inlay restoration is much bet-

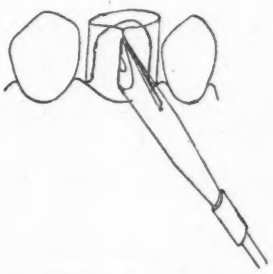


Fig. 4.—Matrix retainer with band loosely fitted to prepare tooth.

ter for many of these cases because the tooth does not have to be subjected to such radical preparation, and as for esthetics, the labial and buccal surfaces may be cut away and veneered with porcelain inlays or with silicate cement, thus meeting the demands of esthetics in a fairly satisfactory manner.

As formerly stated, no one step in the construction of a cast restoration is of more importance than any other, as the slightest neglect or inaccuracy in the production of one step is sure to cause failure. In this particular technic, the process has been divided into seven steps, as follows: cavity preparation, making of the wax pattern, investment, elimination

of wax, heating of mold, casting, finishing and cementing. The whole sequence of steps might well be compared to a mason's arch, each step represented by one of the arch stones. (Fig. 2.) In a mason's arch, the strength of the whole is just that of the weakest stone. In the cast restoration, the result achieved is just as good as the most poorly executed step. If any step is neglected, failure is certain. In this technic, no single step is accentuated over the others, but each one has been definitely worked out in a manner which is simple and practical for every-

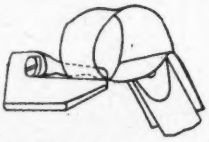


Fig. 5.—Method of contouring matrix band with bridge plier.

day use. Each step will be described briefly.

CAVITY PREPARATION

In all cavities for inlay restoration, Black's principles may be used with only slight variations which this particular method make necessary. The extension and outline form is practically the same as for any other material, the greatest point of difference being that all cavity walls should be parallel or slightly divergent in the direction of withdrawal. As far as possible, the directions of withdrawal should be directly opposite the principal stress to which the restoration will be subjected. This will give the maximum of retention and resistance to stress. By the exercise of good judgment and ingenuity, this principle may nearly always be followed. All cavity walls should be finished smooth without the slightest undercut or roughness. This should be done, if possible, with true-running cylindrical stones, where the size of the cavity will permit, or, in small cavities, with cylindrical burrs. Chisels and cutting instruments may be used to get the general outline, but should not be used for finishing, as with their use it is almost impossible to get cavosurfaces sufficiently accurate and smooth. All margins should be beveled, especially cervical margins. They should be ground and polished smooth by the means of disks and fine stones wherever possible. Many practitioners consider the test of an accurate cavity to be an easy withdrawal

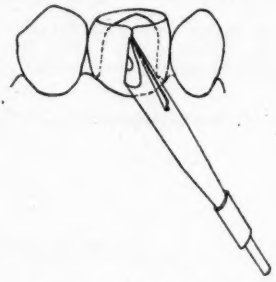


Fig. 6.—Contoured band fitted to tooth.

of a wax pattern. As a matter of fact, this is no test at all, as all waxes are somewhat elastic and will spring out of small undercuts and irregularities without any perceptible resistence. But when such a pattern is reproduced in gold, which is a hard resistance substance, it will be found impossible to seat the inlay completely. Every practitioner who has cut cavities and done experimental casting in extracted teeth will appreciate the truth of this statement. And permit me to say that everyone who attempts to use inlay restorations should first do a great deal of technic work on extracted teeth. I know of many instances in which practitioners have been using inlay restorations for years, doing work which they evidently considered good, in the mouth,

but who were absolutely incapable of cutting an accurate cavity in an extracted tooth and making an inlay which would fit it; an achievement which is infinitely easier than the same procedure in the mouth.

MAKING THE WAX PATTERN

The manipulation of wax is not a particularly difficult procedure, if its properties are well understood and a few simple rules followed. It should be remembered that wax is a plastic and has much

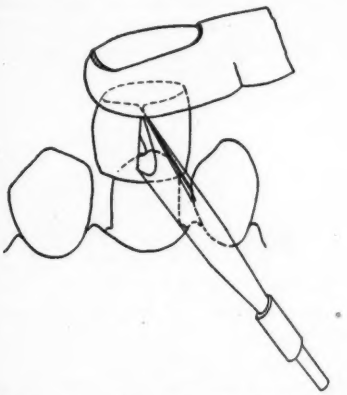


Fig. 7.—Use of matrix band in forcing wax to position on prepared tooth.

the same physical properties as all other plastics, and if the operator will only work in conformance to these physical properties, his difficulties in this direction will be minimized. If a perfect pattern is to be made for any other than a simple cavity, it is necessary that a suitable matrix be used. This is to secure condensation and adaptation, which are necessary. In simple cavities, all that is necessary is to soften a cone of wax, forcing it to place and holding it under pressure until it has become cool. The excess is then carefully removed and the pattern carved to anatomic form. In all cavities involving two or more surfaces, a matrix should be used. When it is possible, a full band is desirable and can be used in all cases except where the approximal contact is so tight that the band cannot be forced between the teeth. It is usually advantageous to use a band held in some type of matrix retainer rather than a seamless band or one which has been cut and soldered to fit the case. (Fig. 3.)

The Onderdonk matrix retainer is very good for this purpose, and as a band material, 36 gage annealed copper is suggested. This material is pliable and soft and can be easily trimmed and contoured to form. In the employment of this instrument, a piece of matrix material is cut about three-fourth inch longer than the

Fig. 8.—Correct mounting of sprue.

circumference of the tooth that is to be fitted, and a little wider than the distance from the cervical margin to the occlusal surface. The matrix band is then inserted in the retainer, placed over the tooth and drawn up to a loose fit. (Fig. 4.) It is festooned with curved scissors to avoid injury to the gum tissue, and trimmed just short of occlusion. (Figs. 5-6.) With a bridge utility or a Benson plier, it may be contoured as desired to produce proper anatomic form for the pattern. The inside of the band is then slightly lubricated and is filled with wax by first melting it into a large spatula and pouring it into the band, the occlusal end being closed with the tip of the finger on which a little of the lubricant has been placed to prevent sticking. The wax is then allowed to cool to the correct consistency. This can be learned in a few trials. It is best to allow the wax to assume a semisolid state before it is forced

into the cavity. The occlusal end of the band is closed by the tip of the thumb, and it is centered over the tooth and carried to place, excess wax being allowed to escape ahead of it as it is moved downward on the tooth. (Fig. 7.) The wax is held under heavy pressure until it has been thoroughly chilled by cold air or water. Occlusion may be registered by having the patient close after softening the occlusal portion of wax to a slight depth with a hot instrument. The excess is then roughly carved away; the retainer removed from the band, and the band carefully loosened and pulled away without dislodging the pattern. The

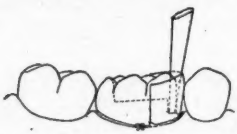


Fig. 9.—Matrix ligated to tooth and wax in position before forcing into the cavity.

pattern is then carved to form, care always being taken to rest the cutting edge of the carver on the enamel margin to prevent submarginal carving. The greatest care should be exercised to get the pattern as nearly perfect as possible, as the inlay cannot be better than the pattern. When carving is complete, the accessible surfaces of the pattern may be smoothed with a small pledget of cotton which has been slightly moistened in oil of cajuput, eucalyptus or some other suitable material. The pattern is then ready for removal from the cavity. This should be done by first heating a small sprue and then melting it into the pattern at the proper point (Fig. 8), and removing it by gently applying traction in the direction for withdrawal. The greatest care should be taken to avoid distortion. It is never permissible to use an explorer for the removal of the pattern, as by its use it is very difficult to apply traction in the correct direction, and also the length and size of the instrument prevents the delicacy of touch which is so necessary. On removal, the pattern is carefully examined for defects, and if any are found, it is returned to the cavity for correction. If defects of a serious nature are found, it is usually best to make another pattern. A pattern made by this technic is very stable and will not appreciably change form unless sufficiently heated to soften the wax. The foregoing instructions apply to such cases as will permit the use of a full band matrix. For all other compound cavities in which the

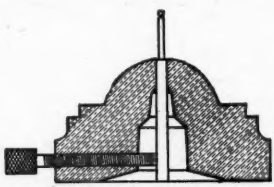


Fig. 10.—Mounting of sprue and cross-section of special sprue former with sprue in position.

approximal contact is so tight as to prevent this, proceed as follows: A small piece of 36 gage copper matrix is cut to a width slightly less than the distance from the cervical margins to the occlusal surface of the tooth. This matrix is then placed between the teeth and ligated to position with silk floss, care being taken not to draw it too tightly. A cone of wax is softened and drawn out to a point, pains being taken to have the point considerably softer than the balance of the cone. (Fig. 9.) The point is inserted in the proximal portion of the cavity and the wax carried to place with a firm, steady pressure. It is then held securely while being chilled. From this time on, the procedure is exactly the same as if a full band matrix had been used. In removing the

excess of wax at the cervical margin, it is desirable that a slight overlap be left. The pattern is then mounted in the sprue-former and the small thumbscrew is tightened to hold the sprue securely in position. (Fig. 10.) It is then immersed in a cleansing fluid by inverting the former and placing it in a wide-mouthed bottle containing cleansing fluid. (A 3 per cent solution of hydrogen dioxide is suggested for this purpose.) The bottle must contain enough fluid to completely cover the pattern. It should be left in the fluid for at least one minute. This will thoroughly remove any blood, saliva or other foreign material which might be adhering to it. It is then removed and blown dry and is ready for investing.

INVESTING THE PATTERN

A special investing material for this technic is furnished, sealed in air-tight envelops, containing enough material to invest one inlay. This saves weighing or measuring and also prevents deterioration of the investment through absorption of moisture from the air. It also insures a correct mix every time, it being necessary only to measure out a sufficient quantity of water to make the mix. The water should be of such temperature that the completed mixture be tepid. The use of a mechanical spatulator is advocated, as this gives a result greatly superior to hand mixing. In the outfit furnished for this technic, a mechanical spatulator is used, thirty seconds application being sufficient to produce a good mix. When the mixing bowl has been removed from the container, it should be rapped or jarred sharply several times on the bench top to cause the investment to settle to the bottom of it. The investment is then ready to apply to the pattern. This should be done by a No. 1 or 2 round sable brush, starting at a given point and carrying the investment ahead of the brush, taking great pains to avoid entrapment of air. After the pattern is completely covered, the investment may be blown off to make sure that no globules of air have been trapped. It is then carefully repainted. This always secures a better and more

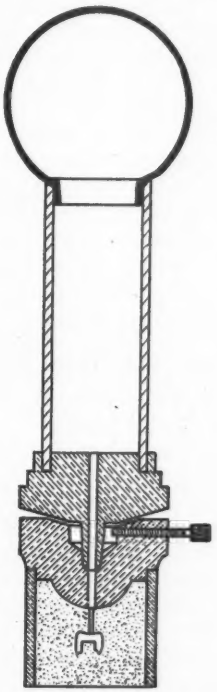


Fig. 11.—Eliminator mounted on sprue former and detail of construction.

even adaptation of investment. The ring is then filled with investment and the pattern inverted and carried to place, care being taken not to trap any air under the sprue-former. The case is then allowed to stand until the investment is thoroughly set. It is then ready for elimination.

ELIMINATION OF WAX

In this technic, a small, simple and efficient eliminator is used which removes the wax from the mold by atmospheric pressure, it being withdrawn so slowly and with so little force that injury of the fine detail of the mold is impossible. The procedure is as follows: The sprue is grasped with pliers and carefully removed from the former, care being taken not to loosen the former in its seat on the ring. The small rubber bulb on the upper end of the eliminator is then collapsed and its conical tip is forced into the conical seat of the sprue-former, making a hermetically sealed joint. (Fig. 11.) This causes the wax contained in the ring to be subjected to very light suction. It is only necessary to place the ring in the hot water container provided for the purpose for a sufficient length of time to soften the wax. It will then flow upward through the sprue hole and into the glass barrel of the eliminator. This will usually require about three minutes, but it does no harm whatever to allow it to remain longer as the very slow passing of water through the investment cannot do it the least harm. When the wax has been eliminated, the ring is removed from the heater and the sprue-former carefully removed, great care being taken to prevent small particles of investment from dropping into the sprue hole as this will be sure to cause a defective casting. It is best to hold the ring in an inverted position and carefully scrape or brush away any loose particles that might be adhering about its edge.

HEATING THE MOLD

After the wax has been eliminated, it is necessary to heat the mold to drive off free moisture and the water of crystallization. As a ring of a definite size has been used, and a definite quantity of investment, it is evident that, given a certain temperature, a definite time will be required to produce this result. An automatically heated and timed oven is furnished for this purpose. The ring is placed within this oven and the clock is set for the amount of time required, that is, twenty minutes. At the end of that time, the ring will be automatically ejected from the oven. It is then ready for casting. It is possible to dry out two rings simultaneously, the time required being thirty minutes. The casting should be made at once, while the ring is still at its maximum temperature.

CASTING

The use of an air pressure machine is advocated, as neither the contrifugal or the suction type will approach it for accuracy of results. With the outfit used with this technic, a very simple type of automatic air pressure machine is furnished. This machine has no pressure regulator of the diaphragm type, its place being taken by a small tank having a capacity of about 120 cubic inches. This tank is attached to the air supply by a pipe containing a needle valve, and attached to the tank is a pressure gage which is plainly visible. The needle valve is opened sufficiently to allow the air to enter the tank to the pressure which is desired for casting. For instance, if it is desired to cast with 20 pounds pressure, the needle valve is opened until the pressure gage registers 20 pounds, and is then closed. This assures a definite pressure for casting, and also assures that, at the very moment that the metal is forced into the mold, the maximum pressure will be exerted thereon, which is not always true of a machine having a diaphragm pressure regulator. A casting pressure of not less than 15 pounds is recommended.

To cast, insert the ring into the base of the machine, place the gold to be cast in the crucible and fuse with a good high-heat blowpipe, adding a little reducing flux. In localities where a good grade of artificial gas is to be had, a gas and air blowpipe will be adequate. In localities where the quality of the gas is inferior or where natural gas is used, a gas and oxygen blowpipe will be found desirable. It is highly desirable in casting to heat the gold only to the point of complete fluidity, as overheating is very destructive to the highly complex alloys which are used today, and it also has an effect of seriously injuring the surface of the mold, thus producing a rough and inferior casting. Just what the correct temperature is is hard to explain and must be learned from experience. After the casting is made, the machine should be left closed for at least a few seconds, to allow the metal to become congealed before the pressure is removed therefrom. On removing the ring from the machine, throw it in water, remove the investment compound from the casting, heat the casting to redness, and drop it into the hydrochloric acid for cleansing. It will probably be necessary to do this two or three times as the investment is rather adherent. If each step has been carefully followed as described, a beautiful casting is sure to result, and one which will fit accurately. Do not attempt to seat an inlay, until it has been carefully examined to make sure that there are no small nodules on the cavosurface.

FINISHING AND CEMENTING

How many times we have heard of a perfect inlay. And how few of us have ever realized that if a really perfect inlay had been cast, it would be impossible to cement it in position. For cement, like all other matter, occupies space. Therefore, if an inlay really fitted perfectly, the presence of cement in the cavity would prevent it from going to place. In view of this fact, we are justified in assuming that really perfect inlays have never been made, or if they have been made, they have never been cemented. It is not my intention to contend that inlays made by this technic are really perfect, though, as a matter of fact, they do fit very closely, as may be demonstrated by sectioning a tooth containing an inlay. I have contended for the past ten years that the more nearly perfect the inlay, the more essential it is to provide space for the cement. It is evident that an inlay which fits indifferently can be cemented to place quite easily. The more nearly perfect the fit, the greater the difficulty. As formerly stated, cement, in common with all other types of matter, occupies space, and as our conception of a good inlay is one which shows no appreciable cement line at the margins, it is evident that, to produce this result, the inlay must be completely seated. The space necessary for cement is easily and definitely made by means of the etching process, which I have used for the past ten years. The technic is as follows: The entire outer surface of the inlay and the cavosurface for a width of from 0.5 to 1 mm. is covered with a dark-colored wax. Extreme pains are taken to completely cover the entire margin. The inlay is then dropped in aqua regia (nitrohydrochloric acid), the wax serving as a protective medium to the portion which it covers; the uncovered portion coming, of course, in direct contact with the acid, which dissolves or etches it away quite rapidly. The amount etched away is controlled by the length of time which the inlay is allowed to remain in the acid. This time is from five to thirty minutes, depending some-

what on the strength of the acid and the amount of the etching which is desired. Small inlays require comparatively little. Large mesioclusodistal inlays require more. The full cast veneer crown usually requires the most of all. This method provides a means for largely overcoming the effect of the small amount of shrinkage which exists in all castings, and, in addition to this, provides a space for the cement, this space permitting the inlay to be completely seated and allowing all margins to come into practically perfect apposition. This is presented as a definite controllable method, superior in every way to an attempted grinding away of cavosurfaces to produce the desired results. Inlays which are etched, regardless of size or complication, will go to place very easily and will not bind on the dentinal walls, the stress coming on the margins where it should be. A practical way to demonstrate the extreme difficulty experienced in cementing a well-fitted inlay is as follows: Place the inlay in the tooth, finish it down completely, and adjust the occlusion accurately, making sure that it strikes neither too hard nor too lightly. Allow the inlay to be worn in this condition for several days, and if the occlusion has been correctly adjusted, the tooth will remain perfectly comfortable. Remove the inlay, and without treating it in any way whatever, cement it in the ordinary manner; and in practically every instance, it will be found that the margins do not register accurately and that the inlay is in hyperocclusion; which proves definitely that it has not been completely seated—the cement has prevented this. On making another experiment such as this, with the exception that the cavosurface of the inlay is etched on cementation, the inlay will not be in hyperocclusion and the margins will be found to register quite accurately, and need little, if any, further finishing. As a rule, inlays should be practically finished before they are cemented. The technic of finishing is much the same as with gold foil. Margins, where accessible, may be ground down with small knife-edge stones, and finished with suitable disks. Cervical margins and others which are somewhat inaccessible may be finished with files and strips. When finishing is completed, all margins should be carefully tested with a fine explorer to make sure that they are good. The inlay is then removed from the cavity, and, if possible, the rubber dam should be adjusted to assure maintenance of dryness during cementation. The cavity is flushed out thoroughly with warm water, and is then cleansed with 3 per cent solution of hydrogen peroxid; or better, with a one-thousandth solution of mercuric chlorid in 3 per cent hydrogen peroxid. It is then dried and carefully wiped out with a pledget of cotton saturated in chloroform. It is now ready for the reception of the inlay. It is my contention that alcohol is not a desirable material for cleansing a cavity prior to cementation, for several reasons. First, it is a coagulant; if any saliva, mucus or blood is in the cavity, they will be coagulated and become very difficult to remove. Alcohol is also a powerful dehydrating agent, and for that reason its use is painful. It is liable to cause too much dehydration, especially if the dam is in position. When the toilet of the cavity has been completed, the cement is mixed. Mixing of the cement itself is quite an art, but this phase of the matter will not be enlarged on at this time. I would suggest that every dentist have the mixing of the cement which he uses demonstrated to him by a factory representative. The cavity is then generously coated with the

cement, which should be of quite a thick, creamy consistency. The cavosurface of the inlay is coated, and the inlay is forced to place in the cavity, and malleted quite vigorously, to make sure that it has been driven to its seat. At this time, the cement should be wiped away from the margins on the occlusal surface to make sure that they register. If there is a slight discrepancy, further malleting will be necessary. All margins should then be carefully burnished, lengthwise. Regardless of the fact that a so-called hydraulic cement may have been used, it is better to maintain dryness until initial setting of the cement has occurred. This time will vary according to the cement used, climatic and atmospheric conditions and the manner in which the cement has been mixed. After the cement has set, so that it is brittle, it may be carefully chipped away and any further finishing and polishing necessary may be done with fine disks, strips and bristle brushes, with pumice stone, followed with dry chalk to give a high luster.

The greatest need today in this field is for better dental cements, those which are insoluble under all conditions and which are more adhesive and less friable. If such a material could be had, and it undoubtedly will be in time, the gold inlay would rival the foil filling from the standpoint of durability. Another improvement—and this must come from the metallurgist—would be gold alloys which show less volume change when passing from the molten to the solid state, as the shrinkage of gold is an ever-present problem and one which, to date, is difficult of control.

This technic has been developed and this paper written in the interest of standardization. A careful consideration of the technic as described will bear out this statement. Every precedure is definite, and under no consideration is it subject to any change or variation whatever, regardless of the character of the restoration as to size, complication or bulk.

To recapitulate: A definite standard and principle of cavity preparation has been given; also, a technic of constructing wax patterns which is simple, definite and well suited for all types of restorations. For investing, a mechanical spatulator is used which revolves at practically a constant speed of 1,000 revolutions a minute. It is allowed to run for thirty seconds; thus, the degree of spatulation is always constant. The investment is weighed out in definite charges and is sealed in air-tight envelops; which prevents deterioration by the absorption of moisture from the air or by contamination from any other source. A definite amount of water for the correct mixing of a charge of investment is secured by measuring. It will be readily understood that, given an exact weight of investment and an accurately measured quantity of water plus a method of spatulation that is always constant and uniform, every mix of investment will be identically the same.

As to the method of elimination, let it be said that it is so simple and positive in its action that there can be no variation in the result which it produces. That is, there is rapid and complete elimination of the wax, leaving the mold entirely free of any carbon or residue of any kind, and its pores open so that the air contained in the mold can readily escape when the casting is made. All of this is done without destroying the slightest line or detail which will permit making a casting which is almost a perfect replica of the wax pattern. It is not desired to leave the impression that results produced by this technic are due entirely

to this particular method of elimination, for such is not the case. It is true that the method of elimination has largely permitted the degree of standardization achieved; yet it must be remembered that it is the manner in which all steps are executed that is responsible.

In heating the mold preparatory to casting, it is only necessary to carry the heat sufficiently high to drive off all free moisture and the water of crystallization, and to secure the amount of expansion of the investment material that is desirable; for it must be remembered that an expanding investment is used. A definite quantity of investment is used for each case in which the proportions of water and investment material are constant. This being the case, it is possible to adopt a standard oven heat and to subject the invested case to this heat for a given length of time, thus constantly producing the desired result, that is, the complete removal of free moisture and the water of crystallization, and proper mold expansion.

In casting, the mold has been so prepared that it is sufficiently porous and yet strong enough to withstand without distortion a comparatively heavy casting pressure. The matter of casting pressure has been well taken care of as heretofore described by securing regulation by means of a small tank or container which has previously been filled with compressed air to the desired pressure. When the casting is made, the machine operates very quickly, allowing no appreciable interval in which the molten metal might become partially congealed, the full pressure being applied instantly just at the desired time.

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PLASTIC REGISTRATION OF MANDIBULAR RELATIONS*

By JOHN H. HOSPERS, A.M., D.D.S., Chicago, Ill.

THE registration of the movements of the human mandible on an instrument seems to have been the main puzzle in denture construction for the last fifty years. It seems, on first thought, that this should be simple enough, but, on closer examination, it becomes a problem worthy of a Solomon.

Volumes have been written on the movement of the temporomandibular joint, and scores of instruments have been devised to reproduce those movements; but, so far, none have succeeded except the relator, an instrument invented by Joseph Homer, of New York City, which is truly adjustable.

The principle involved in the relator is the registration of the condyle paths in a plastic material that solidifies on becoming cold. The guiding principle in developing these registrations or negatives is an occluded set of teeth, or teeth set up on grafts base-plates and true wax rims, tried in the mouth for esthetics, and correct central and check-bites from these trials. (Fig. 1.)

*Read before the Section on Full Denture Prosthesis at the Sixty-Ninth Annual Session of the American Dental Association, Detroit, Mich., Oct. 26, 1927.

Before we go into a discussion of the relator, it will be necessary to determine a correct method of obtaining central occlusion.

Modeling compound impressions are taken of both the upper and lower jaws and removed from the impression trays. Key grooves are cut in the outside of the impressions over the ridges, to act as aids in properly reseating the wax bite, to be taken later. A scribing instrument (Figs. 2-4) is used to mark the depth of the impression on the labial side of the compound, and then mark the median line on each impression. Next, bite wax is molded over a piece of aluminum (Fig. 5) bent into a horseshoe form, or a Homer bite tray, and, with this as a tray, an impression is taken of the lower ridge. A pyramid of soft bite wax is added at the median line and patient is instructed to close slowly until told to stop. The impression is cooled and checked for correct facial length and outline, and if too high, the upper part of the wax pyramid is softened or pooled and the operation is repeated.

If closed too far for symmetry, wax is added to the upper part of the wax pyramid. When the operator is satisfied as to face form and contour, wax is added on each side of the central portion to make a complete wax bite.

The median, rest and high lip line of the upper lip and the low lip line of the lower lip and angles are marked. (Fig. 6.) Next, a triangular piece is cut from the labial plate of the wax at the median line, both upper and lower, the apex of the triangle to be at the crest of each ridge impression.

The distance between the two cuts or ridge crests is measured with a set of calipers. This is called the intermaxillary bite.

The impressions are placed in the mouth (Fig. 7) (an articulator is used to show work clearly), and one beak of the caliper is inserted in the intersection of the two lines scribed on the lower impression, and the patient is asked to close until the other beak can be inserted into the intersection of the two lines on the upper impression. This will gage the amount of wax necessary to get the correct intermaxillary distance. Base-plate wax is softened, formed to the ridge and placed over the lower impression. The technic of the caliper is repeated, and

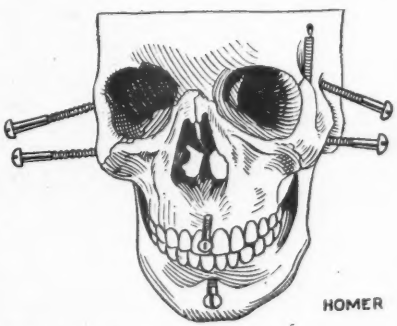

Fig. 1.—Plan on which the relator was based. The upper of each set of screws is stationary and the lower one is movable. One is in the symphysis and the other two are, one each, in the condyle.

when the upper beak has entered the intersecting point, the wax is cooled.

The surplus is trimmed away and the wax reseated on the lower impression, and the patient is asked to open and close repeatedly. Checking for shifting is carefully done. This gives the correct centric, viz., "repeated identical closure of the mandible from a nonstressed position."

The casts are then poured, and the impression sealed with this wax bite and mounted on the instrument.

As no individual registrations have been made, the casts are first attached either to the Gysi simplex or to a relator in plain line adjustment, and the teeth set for the average balance.

The trial plates are now fitted into the mouth and the check-bites taken. (Fig. 8.) The recording of the check-bite is one of the most important steps aside from the actual work of balancing the dentures.

The weak link in the chain is the check-bite. Stability of the bases is essential and the use of a retaining powder is a necessity in many cases. J. B. La Due insists that it is necessary in every case, whether there is an evident movement of the base or not. I am beginning to think that this is true, because even a base that has stability has movement on the resilient tissues underlying it. The retaining powder holds it firmly, so that the teeth, which are not yet in true balance, enter the wax check-bite with a firm and definite movement and make a correct record. This also applies to the completed dentures before milling, to correct the movement of the teeth during vulcanization.

The bases must be stabilized in the mouth and the centric occlusion should be correct. The teeth on the trial plates should occlude properly for an open and shut bite. The stability of the bases and also the occlusion should be tested by wedging the point of a penknife blade between the upper and lower molars to detect movement. There should be no movement.

Three quarters inch of the margin of the relator wax register is softened in a flame or hot water and placed over the lower teeth, and the patient is instructed to give a right lateral bite. This wax is cooled *in situ,* and marked with an R on the upper surface, to read from the front. The left lateral and protrusive bites are taken in succession and marked for future identification. The opening in the wax permits checking the incisors for correct closure, which should be at least the distance of one half the width of an upper incisor to right or left. The wax forward of it should be kept cool. It

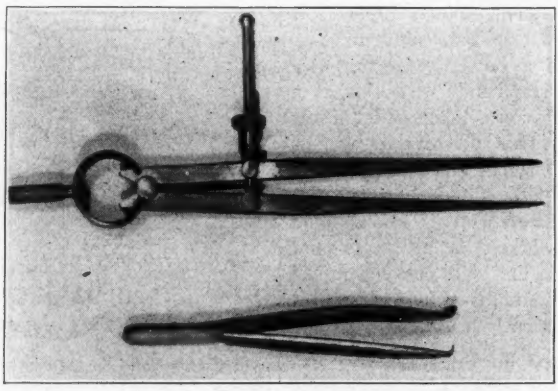

Fig. 2.—Dividers with a set screw and also scribing instrument.

serves as a handle to place the register over the lower teeth.

If the central occlusion was not correct, additional registration must be taken for it. If the casts have been mounted on a plain or fixed line instrument, they are now removed and mounted on the relator for balancing according to the individual condyle and incisor guide requirements of the case.

The two trial plates are reseated on the casts and sealed together. The lower cast is attached directly over the lower bow of the relator, and after the plaster has set, the upper is attached. If both are attached at the same time, the expansion of the plaster will open the bite. No face-bow is used for mounting the casts.

I should like to have you realize that no particular care is required in mounting the casts on the relator. It is even possible to mount them with the face to the rear of the instrument, and when the registrations are made in the plastic compound, an analogous path to the individual path will be developed which will give us the same balance as though the casts were more conveniently mounted. This flexibility completely eliminates even a theoretical necessity for a face-bow. In my opinion, no one has ever produced better work with it than can be produced without it, because the temporomandibular joint is not a pivot hinge.

Dr. Homer has coined the term occlusodontia as the science of positioning or relating opposing surfaces of teeth for the greatest efficiency of the individual, either by arrangement, construction, alteration or root movement.

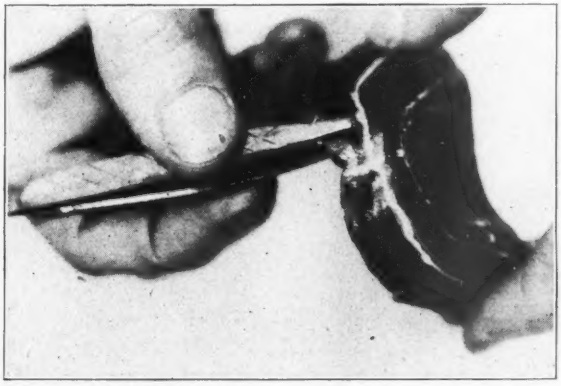

Fig. 3.—Marking the labial of the impression with the scribing instrument. The line on the labial shows the depth of the ridge impression, also the median line.

A short description of the relator seems opportune at this time. (Fig. 9.) A relator is an instrument with a plastic and unlimited range of adjustment to record mandibular relations and but two movable parts. The relator permits reproducing mandibular movements from registrations in a material plastic at the time of registration. It is called a relator because the term "relating teeth" is more expressive than "articulating teeth." It is truly an adaptable instrument, and as

such uses a plastic material to get an unlimited range. It is advisable to oil the cups and condyle extensions to prevent sticking of the compound.

The three screws are set to the heads before the casts are attached. This puts the dentures in centric occlusion as far as the relator is concerned, and it is always possible to return to centric occlusion at any time by resetting the screws. Modeling compound is now heated and both condyle cups are filled with it. Without changing the position of the screws, the extensions on the relator, or condyle arms, are dropped into the plastic compound and the instrument is centered by the screw positions. The arms are oiled to prevent any drag in the compound when removing the arms for the next registration.

The cups are dipped in hot water (Fig. 10) to keep the compound plastic. The screws are raised; the R check-bite, after proper refinement, is placed over the lower teeth. Then the teeth on the upper trial plate are carefully placed in the upper part of the check-bite and slid to rest in that position. At the same time, the condyle arms are drawn through the plastic compound and form the path for this right lateral registration. If we desire to make but one registration, the compound can be cooled and removed and similar registrations can be made for the left lateral and protrusive bites. This would give us three separate sets of cups, each moving to and from central occlusion in that bite only. There is an instrument on the market that does that and no more.

The relator is far more flexible in that all three registrations are made in the one piece of compound. This duplicates all the lateral and forward shifts of each individual patient, in one set of negatives.

This also eliminates the necessity of changing the compound in the cups or, as in Dr. Hall's instrument, of resetting the slots and recording dial markings. The full record also helps in milling, in that we can mill to, from and past central occlusion, while Dr. Hall's instrument mills only to and from central occlusion in each position, necessitating adjusting a number of screws and disks for each instrumental movement.

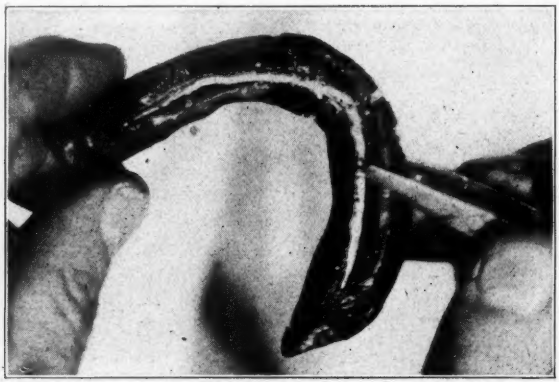

Fig. 4.—Marks on lower impression (compare Fig. 3).

To continue with the various registrations formed by the condyle arms while the compound is still plastic, after the central and right lateral registrations have been made, the R check-bite is removed and the L check-bite is placed over the lower teeth.

The compound in the cups is kept plastic by dipping the cups in hot water from time to time. Then, the upper teeth are carefully placed in the upper impressions of the check-bite and shoved to position. In the process, the condyle arms make the path for the left lateral bite, in the plastic compound. We now have the central right and left condylar paths traced in the plastic compound.

The upper bow is removed once more and similar procedure is used for registering the protrusive bite. (Fig. 11.) The central screws are again set to the head and the upper bow replaced in central occlusion and the compound cooled. Irregularities in the compound are corrected with Kingsley finisher if there should be any ridges between the registrations. The incisal cup is now filled with plastic compound and the different registrations are made from central through right, left and anterior bites, using the same technic as for the condyle cups. The incisal registration helps to bring the instrument back to central occlusion at every movement, and also lifts

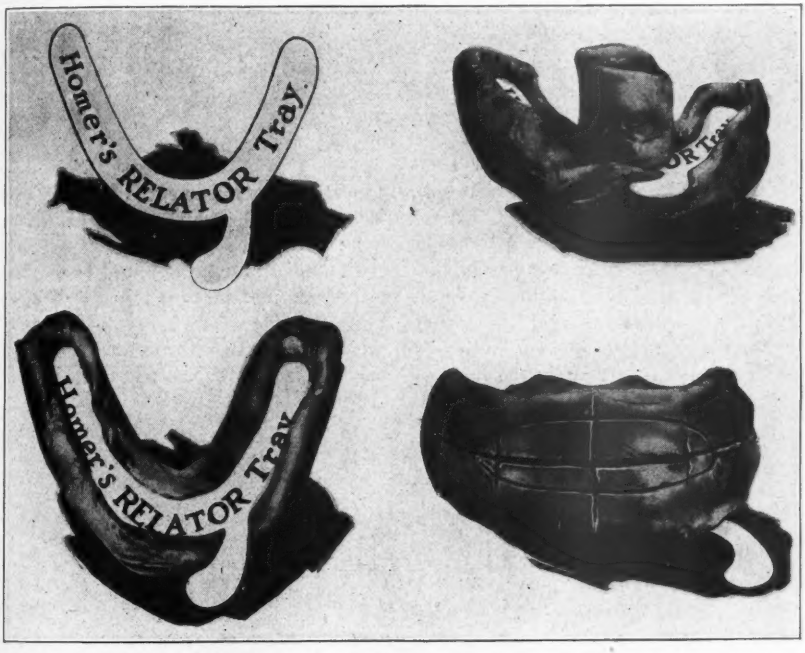

Fig. 5.—Method of building up the intermaxillary bite to determine the face form and central occlusion.

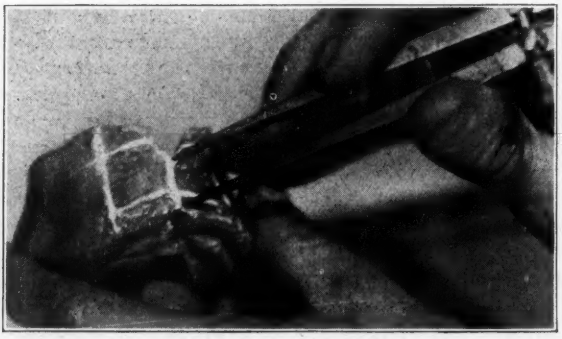

Fig. 6.—Triangular pieces cut from the intermaxillary bite at the median line and the distance between the ridge crests measured.

the teeth to the bite on the opposite side from which the thrust was made. Therefore, the incisal cup guidance is essential for the original balance, but can be dispensed with when the milling is being done. If a cross-section of the incisal registration is made, it will show Gysi's gothic arch. The arch is in the form of a pyramidal depression. The sides are inclined to the correct incisal guidance.

Dr. Hall contends that a straight slot is all that is necessary to and from central occlusion for condylar guidance. (Figs. 12-13.) There is no controverting the statement that the condyles do not move in straight lines; nor do they fol-

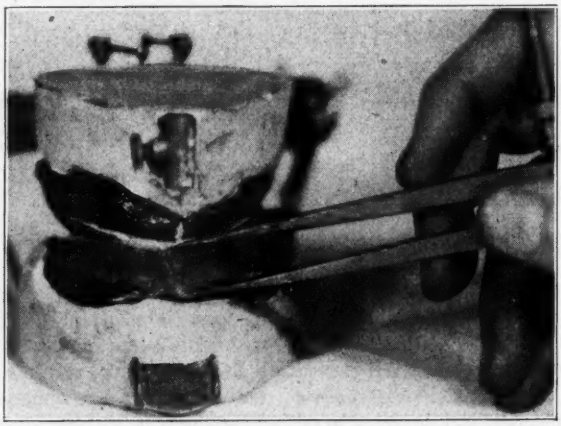

Fig. 7.—Impressions mounted on the articulator for demonstration, showing the method of obtaining central occlusion. The dividers are the same as in Figure 6 and points are placed in the intersection of median line and scribing on each impression.

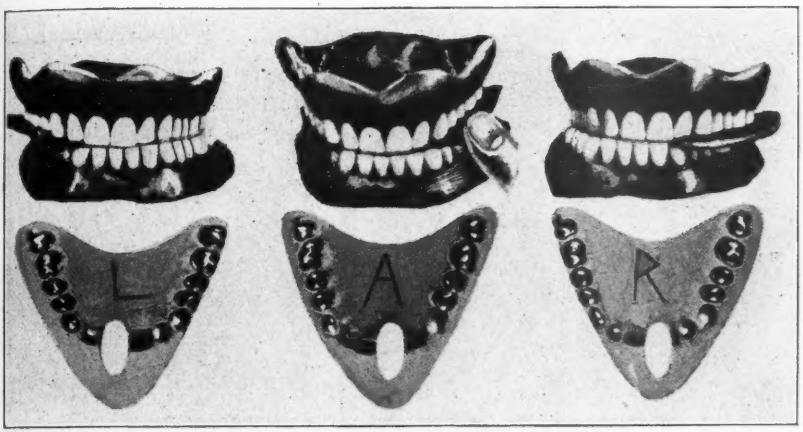

Fig. 8.—Method of preparing relator registers.

low any predetermined path, as Dr. Homer has pointed out. Seldom do two mandibles move so nearly alike that their movements can be interchanged for mechanical purposes, if best results are desired.

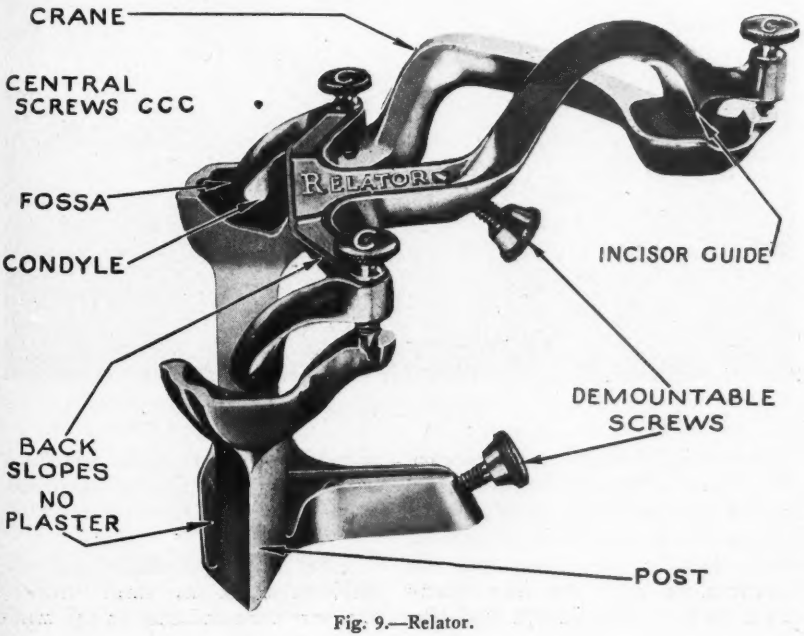

Fig. 9.—Relator.

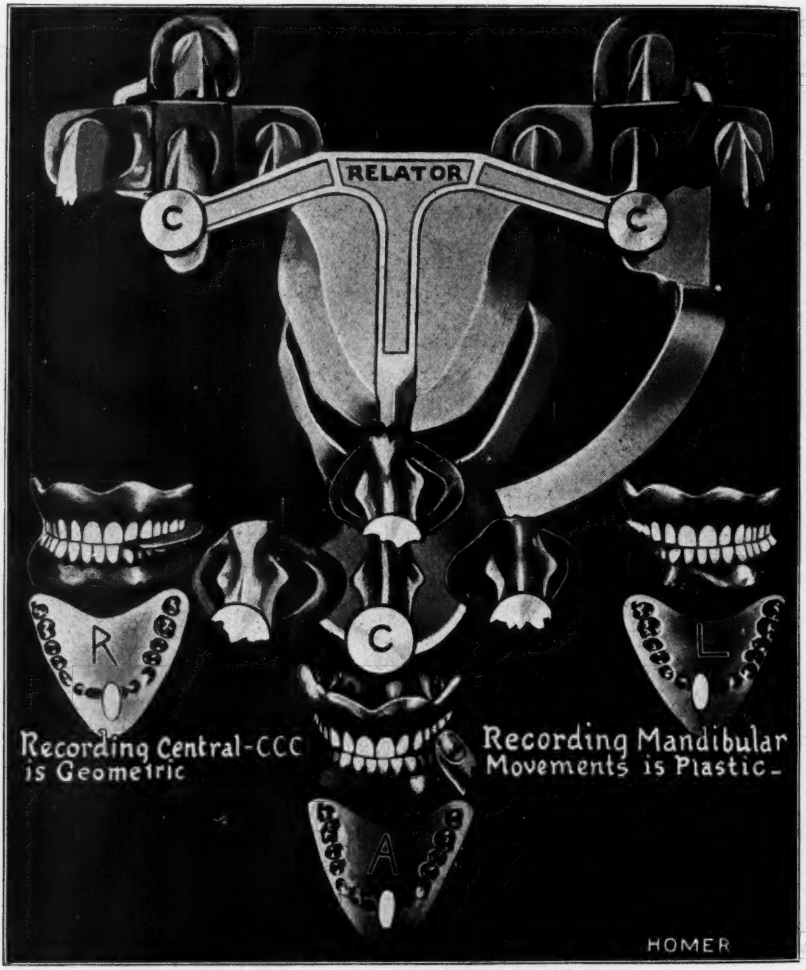

Fig. 10.—Relator.

The bolus of food has an influence on the position of the condyles, because it tends to force the condyle on the working side up into contact with the glenoid fossa, while the lever action pulls the condyle on the opposite side from its contact in the fossa. Probably the check-bite has this effect on the condyles, and I have frequently put a double thickness of wax on the balancing side when taking the check-bite.

It may be possible and may seem reasonable to expect that small variations have very little influence on the masti-

cating efficiency of the patient, but we must not overlook the many and varied influences that the mucosa and underlying structures exert on artificial dentures. (Fig. 14.) Therefore, if the foregoing premise is accepted: that the condyle does not move in a straight line, I wish to propose the following axiom: right to left is 180 degrees and that there are an infinite number of intermediary planes from one lateral thrust through the protrusive to the other lateral and then also the side shift, we realize that a plastic registration can be the only accurate method. A fixed slot set for one direction may be accurate for that movement

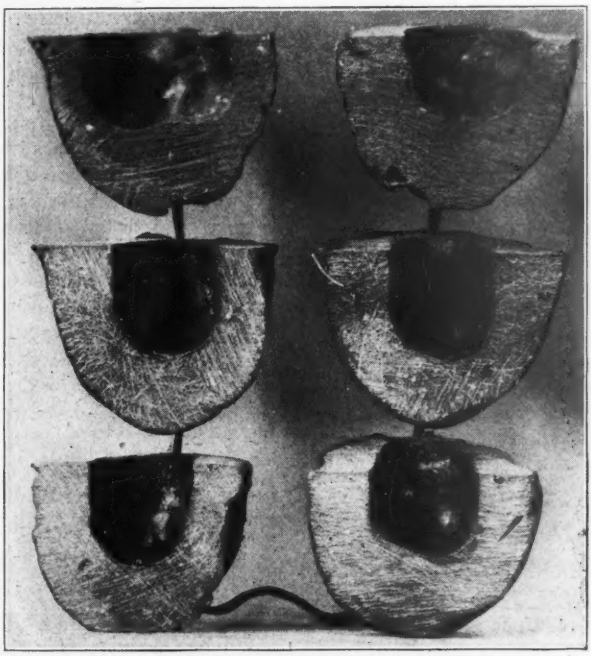

Fig. 11.—Change in negatives from central occlusion through all steps.

Neither, then, is it possible to force it to follow a mathematically predetermined slot when constructing an artificial denture. Let us for a minute consider the many things that influence its movement. In addition to the movement of two arcs and a chord, there may be a side thrust in which the whole mandible shifts bodily to the right or left. When we consider this thrust and realize that a shift from but that one only. And what about the hundreds of other possible movements?

Let us compare the plastic registration to the making of a phonograph record. The steel needle, actuated by the vibratory disk responding to the voice, makes an irregular line on the surface of the wax plate. This wax is treated and copper plated, and from the copper plate, a vulcanite record is formed. From this,

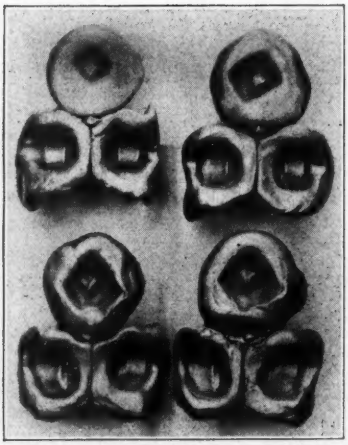

Fig. 12.—Various forms of paths in the compound negatives.

we can reproduce the original peculiarities of the voice.

No mathematical device can make the line on a phonograph record. So the infinite and imperceptible variations of the individual condyle paths can only be reproduced in a plastic material with the aid of the check-bite and an instrument like the relator with only two moving parts.

If we have proved the possibility of obtaining an accurate tracing of the condyle movement, the remainder is purely a technician's task, merely transferring this movement into the appended dentures.

The proper compensating curve is now worked out as follows (Fig. 15): Place one beak of a pair of set calipers at the tip of the distobuccal cusp of the upper second molar and mark the lower cast with the other beak vertically beneath it. Using the guiding planes established in the incisal and condylar pieces of compound, push the teeth into the balancing bite on that side and again mark the plaster vertically beneath the distobuccal cusp of the second molar. Connect the two points on the plaster. This line gives the angle for buccal cusps of the molar. The wax around the second upper and lower molar is then softened, and the combined axis of these teeth tilted at right angles to the line just drawn on the lower cast, and then balanced for working and balancing bites.

The second molars on the opposite side are similarly treated, and from that, the balance for the denture is easily worked out. No matter how good the

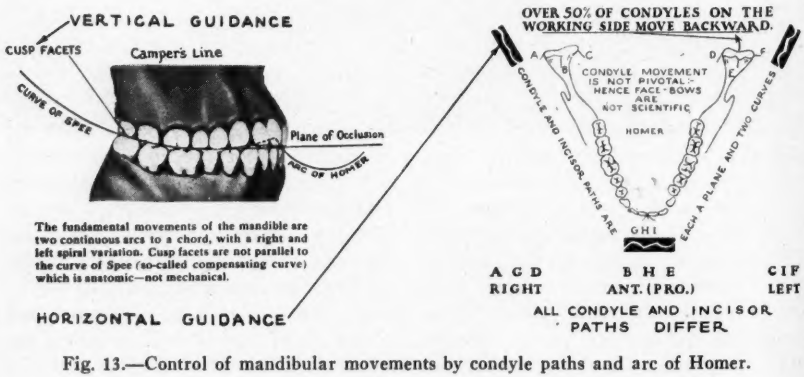
VERTICAL GUIDANCE
CUSP FACETS
Camper's Line
CURVE OF SPEE
Plane of Occlusion
ARC OF HOMER
The fundamental movements of the mandible are two continuous arcs to a chord, with a right and left spiral variation. Cusp facets are not parallel to the curve of Spee (so-called compensating curve) which is anatomic—not mechanical.
HORIZONTAL GUIDANCE
OVER 50% OF CONDYLES ON THE WORKING SIDE MOVE BACKWARD.
A
B
C
D
E
F
CONDYLE MOVEMENT IS NOT PIVOTAL - HENCE FACE-BOWS ARE NOT SCIENTIFIC
HOMER
CONDYLE AND INCISOR PATHS ARE
EACH A PLANE AND TWO CURVES
G H I
A G D
RIGHT
B H E
ANT. (PRO.)
C I F
LEFT
ALL CONDYLE AND INCISOR PATHS DIFFER.

Fig. 13.—Control of mandibular movements by condyle paths and arc of Homer.

technic or how nearly perfect the instrument, unless the operator has skill, the case will not be so good as it should be.

A few commendatory statements may be of interest.

The famous Marpell case in Detroit was finally successfully completed on the Homer relator.

Rupert E. Hall acknowledges the superiority of the plastic principle over all other methods but his own. He said that the ideal method would be a reproduction of the condyle path in metal, but that the price would be prohibitive. His only objection to the use of compound was that it was subject to distoration.

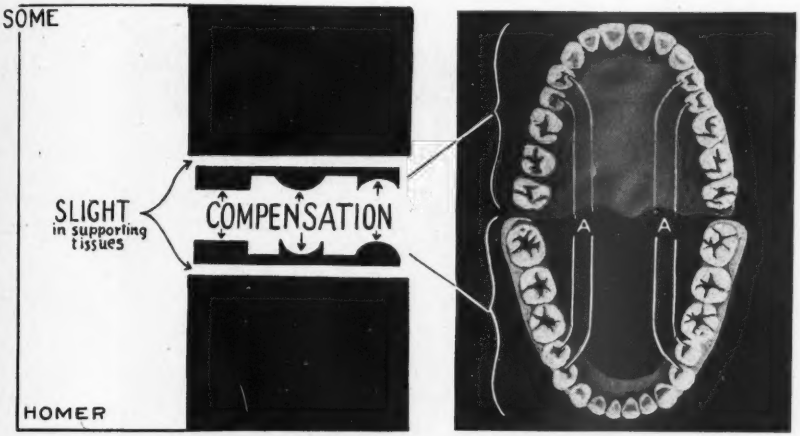
SOME
SLIGHT
in supporting tissues
COMPENSATION
HOMER
A
A
Physiology demands: some compensation in the inter-articular, slight in the supporting tissues, and all possible on the occlusal surfaces, which may be classified, individually or as a whole, as composed of a plane, a convex and a concave curve.
The Area of Occlusion is a horse shoe shaped collection of planes and curves with an indented outline of Harmony
AA. natural central of bicuspids is a cusp-sulcus relation.

Fig. 14.—Profile tissue relation diagram of artificial or natural masticating machine.

Mr. Samuel G. Supplee, of New York City, says: "We are making a great many cases using his (Dr. Homer's) technic, and I can say without qualification that it is the simplest and most direct means of producing balanced occlusion that I know of."

Dr. Gysi, of Switzerland, recognized the irregularity of the condyle paths and even made plates with the S-shaped slots, but was forced to abandon this method because it required an expert diemaker to make the slots for each case.

J. V. Duell of Louisville, Ky., says: "Sufficient stress should be placed on the fact that the compound does not distort in the cups. If you can trust compound for the impression, why not for the condyle registration?"

It is possible to force the mandible to habituate itself to follow an arbitrary path. We see the grotesque results all about us.

When *we* start to wear artificial dentures, they will be more serviceable to us for a longer time if the normal movements of the mouth can be followed.

I have no quarrel with any man as to the best method of recording and reproducing the condyle movements, but I believe it would aid greatly in the advancement of the problem if the personal and commercial element were left out of it.

vised for balancing artificial teeth. I can claim no originality in the preparation of this paper and wish to thank all who have assisted in its preparation, especial thanks being due to Dr. Homer for the use of his slides and photographs.

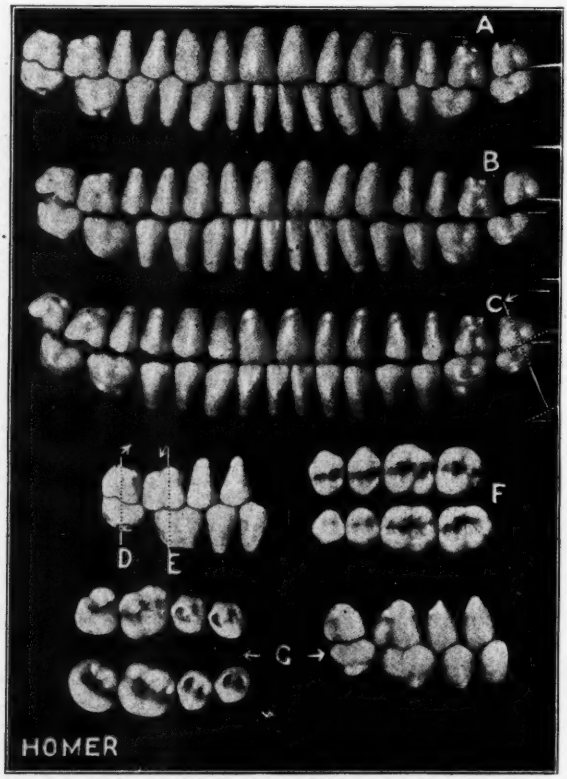

Fig. 15.—Angulating artificial cusp facets.

As an outsider, I think that I have seen the light and I hope that this paper may do something to clear the atmosphere.

After two years of practical experience, I have come to the conclusion that no greater instrument has ever been de-

DISCUSSION

George P. Brenner, Milwaukee, Wis.: The principle of plastic registration of mandibular relations is ideal from a theoretical point of view, but in practice the technic described is subject to many inaccuracies owing to the use of composition base-plates and the check-bites for registering centric, lateral

and protrusive positions. These unstable factors apply not only to this technic, but also to all other technics using these materials, and depend on the ability of the operator to detect these inaccuracies in the finished denture when in the mouth and his ability to correct them. As stated by Dr. Hospers, the check-bite is the weakest link in the technic, and I accept that he includes in that the check-bite for obtaining centric relation of the mandible to the maxilla. He quotes Dr. Homer's rule for registering correct centric relation, "repeated identical closures of the mandible from a nonstressed position," meaning, no doubt, from a nonstrained relation or without strain. This technic, although correct in principle, readily introduces an element of inaccuracy unless it is carefully rechecked. The attempt to register the protrusive and lateral horizontal inclinations of the condyle element in one mass of compound is rather optimistic. I question whether protrusive and lateral relations can be recorded in compound and each record remain definite; and when the patient registers a backward thrust of the condyle element of the working side, there is danger of destroying the positive location of the condyle element in centric relation. This condition may be overcome by recording centric and protrusive relations in one compound record and the lateral relations in another, grinding the dentures in to centric and protrusive relations with the first records and the lateral relations with the second records. With this deviation from the technic outlined by Dr. Hospers, centric relation is retained and the lateral relation more definitely retained. As the plastic method is susceptible of distortion, we should use every means at our disposal to insure accuracy. The method of using separate sets of records as just suggested will insure greater accuracy.

PREVENTIVE ORTHODONTIA IN THE PRACTICE OF CHILDREN'S DENTISTRY*

By EARL E. GRAHAM, D.D.S., Chicago, Ill.

THE subject "Preventive Orthodontia in the Practice of Children's Dentistry" might be interpreted to mean that only those who limit their practice to the care of children's teeth are responsible for preventive orthodontia. On the contrary, it should be the duty of every dentist to study the causes of malformations and to work toward their prevention. Considering the word "preventive" in its derivative meaning, we have "the act of coming before." Therefore, to prevent a condition, we must anticipate its coming and remove the cause.

The need of orthodontic treatment is the result of an abnormal growth or deviation from normal in the development of the arches and arrangement of the teeth. Therefore, to prevent such misdirected growth, it is necessary to review the normal development and study factors which may be the remote causes of malocclusion. If it is possible to diagnose the cause of an orthodontic case, it becomes the duty of every general practitioner as well as orthodontist to foresee the cause in others and prevent a similar occurrence.

In a brief and rather general way, let us review some of the stages through which the teeth and arches pass in their development, considering some of the

*Read before the Section on Orthodontia at the Midwinter Clinic of the Chicago Dental Society, Jan. 25, 1928.

natural forces that are so essential to their proper growth. We are taught that about the sixth week of fetal life the arches take form and the palate begins its formation, separating the oral cavity and nasal opening. At this time, there is a thickening of the epithelial cells over the future alveolar structure which is called the dental band or ridge. This band of cells lies on the crest of the ridge in a groove. A thin dental lamina or sheet of this epithelial tissue is given off to the lingual side in an apron formation. From ten points on this apron, epithelial cords begin their growth downward into the underlying connective tissue, where they take a bulbous form and later become the enamel organ. This occurs from about the seventh to the eighth week of fetal life. The underlying connective tissue forces the underside of the epithelial bulb into a bell shaped structure and becomes the dental papilla or the dentin organ; this taking place about the ninth week. During these three weeks, a bone formation begins, with crypts separating each tooth germ into its respective compartments, and a fibrous tissue forms around the tooth follicle.

By the twelfth week, this fibrous sac has completely surrounded the enamel organ and dental papilla and the epithelial cord from which the tooth started its growth is severed. At this time, a bud of epithelial cells is given off from the severed cords to the lingual aspect of the follicle of the deciduous tooth. It is from this group of cells that the permanent teeth to follow begin their formation. All of the permanent teeth, with the exception of the molars, have their origin in the remnant of the cord of the deciduous teeth. The permanent teeth pass through the same changes in their formation that the deciduous teeth do in theirs. The first permanent molar has its origin in the dental lamina, as do the deciduous teeth. The second molar is formed from a bud of cells given off distally from the epithelial cord of the first molar; and the third molar, from the cord of the second. By the fourth month in the development of the fetus, the tooth germs of all the temporary teeth have been inclosed in their follicles and the enamel organs for the corresponding permanent teeth have begun their development.

About this time, the formation of enamel and dentin of the deciduous teeth begins. The enamel is laid down from different points on the occlusal surface and progresses in all directions. These points move farther apart with the formation of the dentin, their junction or fusing place often becoming an irregular or imperfect pit or fissure. It is in these resultant defects that flora of the mouth or lactic acid forming bacteria are sealed, until this imperfect layer of enamel is destroyed and the dentin is exposed to the effects of the acid, caries being the result. To this, we shall refer again.

At birth, the crowns of all the deciduous teeth are formed and lie in their bony crypts. The crowns of the four first permanent molars are almost completely formed. The follicles for all other permanent teeth, except the second and third molars, are present.

Up to this time, the delicate growth and formation of these different cells and tissues have been dependent on the fetal circulation and the nourishment received through the blood of the mother. The growth has been, up until this time, mostly due to the force of the multiplication of cells and the expansion due to the size of the bone and dental organs.

At birth, the entire maxilla is a conglomeration of developing teeth; even most of the area which later becomes the

maxillary sinus is occupied by teeth. The mandible is likewise a mass of more or less disarranged teeth and tooth follicles. The growth and formation of these organs to their full size before eruption necessarily causes an expansion and growth of the so-called jaw bones, which are to act as the foundation and alinement bars for the teeth as they come into occlusion.

Let us consider some of the forces that directly or indirectly affect the growth of the arches; first, we might say the multiplication of cells in the tooth germ in that vascular area which forces the crown of the tooth outward as the dentin or root portion begins to grow. The root continues to form, forcing the coronal portion farther until, after the osteoclasts have removed the roof of the crypts, the tooth makes its appearance through the gums. As they extrude farther, a cancellous bone tissue follows the gingivae, and thus occurs the development of the alveolar process, which gives upper and lower thickness to the two arches.

At birth, it will be noted also that the mandible is a horse-shoe shaped bone with hardly any angle. Without the teeth, the surfaces or crest of the ridges come in contact. During the eruption of the teeth, the angle of the mandible becomes more acute and the ramus begins to lengthen to compensate for the alveolar process and the length of the crowns of the teeth. Whether it is the erupting force of the opposing teeth striking which causes the need of a longer ramus or whether the ramus lengthens ahead of the striking of the teeth it is hard to say, but we know that there is a delicate harmonious synchronism necessary in their growth.

No doubt the muscular force has a great deal to do with the direction of growth of the arches, as exerted, for example, by the muscles of mastication, deglutition and respiration. The constant passage of air through the posterior nasal openings has a tendency to expand that portion, while the lack of it tends to permit a closure through lack of development. It is a well known fact that, in a mouth breathing child, the nasal openings do not develop.

During infancy, crying is a means of normal development. The act of sucking exerts a tremendous force in development of the arches. If a child were fed with a spoon from birth and not permitted to nurse, it would lack the development of those muscles and, indirectly, the bones to which the muscles are attached. In this day of artificial feeding of infants, great care should be exercised in the selection of nursing nipples. Most of the rubber nipples on the market today are from 1 inch to 2 inches long, which permits pressure too far back on the palate. The posterior part of the hard palate is forced upward and against the soft palate are exerted an unnatural force and irritation. The rubber nipple should as nearly as possible represent the shape and size of the mother's nipple.

"In all the process of development, the growth is the result of all the forces to which the bones are subjected, perfectly distributed through the substance of the bone." (Dr. Noyes.) These elements of force act much the same as orthodontic appliances in principle. Any lack of harmony of these forces will cause malocclusion to develop. The lack of growth because of a deficiency in cell food or the death of cells during an illness, or any deviation from a quiet normal life of the child, may be the primary cause of malocclusion. Usually, once a force is wrong, it affects the normal working of another, and the two affect others, until the condition grows from bad to worse, and

later in life, the effects become visible. The stopping or correcting of malocclusion is not real prevention. Real prevention means anticipating and changing the condition that may cause the trouble before it has really begun.

The normal eruption of the teeth is an important factor in the growth of the arches. The two lower central incisors usually come through first, about the sixth month of age. As they erupt, the lateral incisors are in position distally to the central incisors, and distally to the lateral incisors are the cuspids. In this position, these teeth form a wedge, because, as the lateral incisors come through, there must be an expansion of the anterior portion of the arch to make room, and then the cuspid comes through, causing further expansion. Nature has used the same principle to continue this force in the eruption of the permanent incisors and cuspids to follow. Each molar, both deciduous and permanent, in erupting, forces the body of the "jaw bones" forward to make room for itself. Often, by the time the third molars are ready to erupt, the growth of the bones is completed, and, owing to the lack of room, this molar does not grow into line but becomes impacted. If the arches are perfectly formed and in proper relation to each other, the tongue, lips and cheeks have much to do in the alinement of the teeth as they come through.

The eruption of the deciduous teeth is a physiologic process and should not be accompanied by any disturbance in the child's comfort and health. We realize that this statement is contrary to general opinion, and although conditions do arise during this period of the child's life which we are not able to explain, some of the best pediatricians agree that the troubles arise from faulty diet, infection of the intestinal tract and other irregularities, rather than from the natural process of tooth eruption, which is indeed a most delicate one. I believe that an orthodontia case might be prevented if any one or more of the following symptoms accompanying the teething of a child were recognized and the cause removed; namely, loss of appetite, irritability and restlessness, slight rise in temperature, diarrhea, occasional vomiting, less than usual gain in weight, most of which may be attributed to some disturbance in the digestive tract.

As our observation and treatment of these patients is limited to the postnatal period, we are obliged to leave the care up to this time in the hands of the attending physician. At birth, our obligation begins. To prevent the need arising for correction later, it may be necessary to change a habit during the very first stage of infancy. It may be necessary to advise or refer the mother to a dietitian. Probably in a nervous fretting baby with disturbed digestion, the difficulties which so often follow as the teeth erupt may be prevented if the mother will refrain from waking the child from its needed rest to show it off to friends. Perhaps we would be justified in prescribing cod-liver oil or sunbaths each day to develop strong teeth and bones. Some malicious habits may be prevented by early advice. I have heard of cases in which the nurses in the hospital placed the child's thumb in its mouth before it was a day old because it had been their experience that a baby that sucked its thumb did not cry much. And the infernal pacifier is sure to come into a home through some well intending friend or relative if the parents do not get it themselves on the arrival of the baby. It seems to be as common a gift as handkerchiefs and socks are at Christmas. Too much emphasis cannot be put

on the effects of these unnatural forces in misdirecting the growth of the arches and associated parts.

When the little patient is presented in the office for examination, more attention should be given the natural elements or any deviation from normal, or, better yet, there should be more frequent recognition of conditions which may lead to a deviation from normal and later cause malocclusion.

After the deciduous teeth are in their places, the arch must be watched closely to determine whether natural growth or expansion is taking place. It is good practice to take modeling compound impressions, to measure the development frequently over a period of time. If the spaces are not developing by the fourth or fifth year, there is something wrong, and the cause should be sought out and corrected. The source of the trouble may be rickets, tuberculous glands, infected tonsils or adenoids.

Since the most predominate immediate cause of irregularity of teeth and of malocclusion is the premature loss of the deciduous teeth, it behooves the dental profession to guard these first teeth from the ravage of caries. True enough, there is some reason why the teeth are of such nature as to yield to decay; but what has already happened we cannot change, and we must take advantage of the situation as it is. It is not my intention to go into the operative procedure of filling these cavities, but I shall try to point out some of the factors accompanying the decaying of teeth which affect the growth of the bones and the erupting teeth to follow.

Suppose caries should begin between the first and second deciduous molars. The decay progresses, causing an unhealthy condition in that localized area and thereby poisoning the contents of the entire mouth. The contact points are soon destroyed, and although the roots are in their sockets, there is a drifting forward of the posterior molar to the extent sometimes of a millimeter. If this condition is permitted to develop, the caries nears the pulp and the tooth begins to be painful to mastication and naturally is shielded from that function. We have learned that functioning of a part is one of the main stimulants to growth. The pulp dies and the area becomes an enclosed source of infection which does not permit the healthy circulation necessary for growth. And there is also danger of migration of this infection through the child's system. It is thought by some writers that the roots of devitalized deciduous teeth do not absorb as readily as if alive and healthy. If so, this may affect the normal position of the erupting bicuspids.

In case of premature extraction of a deciduous tooth, the healing of the socket tends to contract rather than expand the space. The bone formation in the socket is a hard scar tissue rather than the normal cancellous process. The permanent teeth do not have their path of least resistance to follow by the absorption of the roots of the deciduous teeth, but, on the contrary, have an abnormally hard tissue to break through. Consequently, they most often erupt slightly rotated or a little out of alinement.

The deciduous teeth have an important function to perform. They come into place as the child becomes old enough to take foods requiring chewing. Through the function of mastication, they promote the development of the bones. As long as the first teeth are in normal occlusion, the force is evenly distributed throughout the area. Any deviation or malocclusion will misdirect these

forces and may be the beginning of a severe orthodontic case later in life. Each deciduous tooth has its permanent successor and should be retained in place in a healthy condition until time for its successor to erupt.

Nature has provided a method of changing from the deciduous to the permanent set of teeth without the loss of function and stimulation of the growth of the bones by proper mastication. The first permanent molar comes through into position and is ready for use before any of the deciduous teeth are lost. While the central incisors are erupting, the deciduous lateral incisors and cuspids are functioning. By the time the deciduous lateral incisors are lost, the permanent central incisors have erupted. While the first bicuspids are taking the place of the first deciduous molar, the second deciduous molar and first permanent molars are in use. While the second bicuspid and cuspid are erupting, the first bicuspid and first permanent molar are in place. Therefore, if the teeth and arches have developed normally and been retained in good condition, there should not be any period of development in which function and resultant growth are lacking. These are the normal developments from which any deviation may be the beginning of mal-growth and, later, malocclusion. This has been demonstrated in the laboratory by extracting the teeth on one side of the jaw of an animal and forcing all the masticating of food to the other side. The used side grew to normal size, while the other remained undeveloped.

As the teeth erupt and take their positions in normal occlusion, the inclined planes or lateral surfaces of the cusps of the upper teeth are in contact with the corresponding surfaces of the lower teeth. There are more than 100 lateral surfaces in a full complement of teeth and most of these are in contact with another in normal occlusion. The mesiosurface plane of the upper molar rests against the distosurface plane of the corresponding cusp of the lower molar. Every tooth is directly in contact with four other teeth, with the exception of the four third molars and the two lower central incisors. The movement created by the normal contact of the inclined planes acts as a stimulant to the circulation of blood through the peridental membrane. The pressure is equally distributed. Any deviation from the normal relation of the planes causes an unequally distributed pressure and, in turn, traumatic occlusion and a misdirected growing force.

The orthodontist tries to restore the normal striking of the inclined planes by expanding the arches and regulating the teeth. He also has the problem of retaining them in position. Certainly we must commend the men of this specialty for the very highly developed degree of skill and precision with which they work. While they are doing their service in corrective work, it is the duty of every practicing dentist to befriend the child patient by rendering him preventive service.

The little patient must be made to feel that he is the most important patient that comes into the office. He must be led to believe that those teeth are there for a purpose, and it is his part and ours to keep them in the very best condition. He must be taught something of the nature of the materials of which the teeth are made; that the main body of the tooth is called dentin and is like bone; that the outer shell of the tooth is called enamel and is very, very hard; that if he forgets to brush his teeth, food may lie against the enamel or remain in

a deep groove until it breaks through and reaches the nerve within. All the ill effects which may follow must be explained to him. It should be seen that this same information reaches the parents.

Along with the education of the child and parents goes emphasis on the importance of frequent visits to the office. Nor should any arbitrary rule concerning the interval of time between these visits be made. It might be necessary for one child to be examined every three months, another twice a year; while a third one should be seen every two or three weeks. At these intervals, there should be a thorough cleaning and examination of the teeth. If any marked grooves and pits are found in either the permanent or the deciduous teeth, they should be sterilized and filled by flowing a thin mix of copper cement or some like material into them. This is especially indicated in the first permanent molars as they erupt in a mouth that has been susceptible to caries. At the time of the extraction or loss of the second deciduous molar and before the second bicuspid erupts, the mesial surface of the permanent molar should be perfectly polished. This may prevent that most common cavity, which comes a little later and quite often causes the loss of the tooth.

It cannot be overemphasized that each deciduous tooth should be retained in good health in its place until the permanent tooth to follow is ready to erupt.

When the child has passed the age for the normal change from the deciduous to the permanent teeth, it is well to ascertain by the roentgenogram whether the permanent teeth are in position, and, if they are, to extract the deciduous teeth. But I would say, never extract until the roentgen-ray picture or other evidence shows the presence of the tooth to follow.

CONCLUSION

It is not my intention to leave the idea that every orthodontia case can be prevented. Far from it. Inherited tendencies are not governable. Advice may be conscientiously given but is not always heeded, which makes our efforts toward prevention an educational problem. Even lack of cooperation between the physician and dentist may be an inhibiting factor. And yet I am of the opinion that if we keep in mind the natural forces in the stages of development and see that they were not misdirected, many a case calling for orthodontic treatment may be prevented.

A NEW INSTRUMENT FOR THE MECHANICAL CORRECTION OF CLEFT OF THE MAXILLAE

By CARLETON FOX, D.D.S., Detroit, Mich.

IN reporting a new instrument and a new method of correcting cleft palate, a word of tribute should be paid to the late Dr. Truman W. Brophy, who devoted his great ability to a lifetime of effort for the relief of this affliction. The advances made in modern treatment of this condition are to be credited to his genius and industry. To have known him personally and to have worked under him will remain a priceless memory.

Previous to our modern surgical era, comparatively little regarding cleft palate is to be found in the literature. In 1884, Dr. Brophy devised the clamp which is shown in Figure 1. The clamp made by Dr. Hammond and modified by Dr. Roberts and still known as the Hammond-Roberts instrument varies from the Brophy clamp in that it has three prongs instead of two and the constricting screw is replaced with a swivel. Although these clamps accomplished the purpose for which they were intended, the reason they did not come into general use is that they extended out through the corners of the mouth, and the natural muscle tension, plus the tension of crying or nursing, pushed the clamp from its original position. This necessitated continual readjustment and produced constant irritation of the buccal mucous membrane.

The methods of Brophy, Blair, Gilmer, Logan, Lyons and other men in this particular field call for the introduction of silver wire through the maxillae. The maxillae are carefully manipulated so that the fissure is approximately closed, and the bones are held in position by twisting the several wires together, supporting them on the buccal mucosa by lead plates. The cleft is finally forcibly closed by twisting the wires until the edges of the fissure are brought together, after which they are scarified and sutured. No matter how narrow the cleft, its forcible closing causes marked edema of the entire facial structure. Owing to the excessive force required to close the fissure, it is not uncommon, with these methods, to have a marked pressure atrophy and infection surrounding the lead plates. To perform any of these operations, an anesthetic is required from forty-five minutes to one hour and a half or longer, the time depending on the operator, and the "time-takers," such as the breaking of either the silk sutures or the silver wire, collapse or meet with any of the other accidents that may and do occur.

Pressure will cause bone development. The orthodontist uses this principle in his correction of malocclusion. He knows, from the work of Oppenheim on tissue changes during tooth movement, that gentle, continuous pressure will produce a physiologic development of bone, while if the initial pressure is great, the bone is compressed and trauma

occurs; and this may lead to bone atrophy. It was the application of gentle pressure that Brophy, Roberts and Hammond used in their clamps and the same principle is employed in the clamp here described.

The screw E is unscrewed so that there is free motion of the arms (A and A^1). The screw D is loosened only enough that the labial plate C has absolutely free motion in all directions. The plate is on a swivel that it may be placed either at right angles to the alveolar ridge or parallel to it, permitting the prongs to go either between the enamel buds of

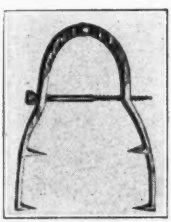

Fig. 1.—Clamp used by Dr. Brophy in 1884.

the central incisors or above them as seems best. The buccal plate B^1 is next grasped with a small pair of curved tissue forceps, in the same position as shown in Figure 2. Under light ether anesthesia, the anterior prong is inserted high in the mucobuccal fold of the long side of the cleft. The plate B^1 is then placed in position by pressing it into the soft bony structures of the maxilla. As the posterior prongs are inserted, the plate C is drawn into position because of the fulcrum created by placing the anterior prong of the plate B^1 in position first. In like manner, the anterior prong of plate B is placed high in the mucobuccal fold of the opposite side, and then with gentle pressure the posterior prongs are inserted, which brings the arms (A and A^1) in closer apposition to the alveolar ridge, as is shown schematically in the middle illustration of Figure 2. Using the socket end of the wrench, screw E is tightened until slight resistance is met. The patient is restrained by the use of corrugated paper cuffs so that it may not touch the arms of the instrument that protrude through the cleft of the lip. Each day thereafter, screw E is given a half turn, or so until the cleft is closed. If the cleft is inclined to close in the shape of a V rather than in the shape of a U, as in the normal dental ridge, the screw D may be tightened by the use of the key, which is a part of the wrench, as is shown. The time it takes to close the cleft depends, of course, on its width.

On the approximation of the fissure, the patient is again put on the table, only a light anesthetic being necessary to scarify the edges of cleft and suture them with horse hair. A slight amount of pressure is again applied by a half or a three-quarter turn of screw E. The appliance is left on the infant in this position until the operator is positive that union has taken place, at which time it is very easy to remove it, no anesthetic being required.

In designing the clamp, the originator had in mind its adaptability to double clefts. When the case presents itself, a V will be taken out of the vomer, as recommended by Brophy and the premaxilla will be retracted to its normal position. The plate C will be inserted in the premaxilla and the plates B and B^1 placed high in the mucobuccal fold as previously described, pressure being applied by screw E. The premaxilla will be held in proper anteroposterior position by plate C, while the maxillae will be brought into apposition by the lateral pressure produced by screw E. When

apposition of the maxillae with the premaxilla is secured, the tissue will be scarified and sutured as described previously, the appliance remaining *in situ* until union takes place.

gold plated. If one desires the germicidal effect of silver, plates B, B^1 and C may be made of a silver alloy, sterling silver being too soft to withstand the pressure.

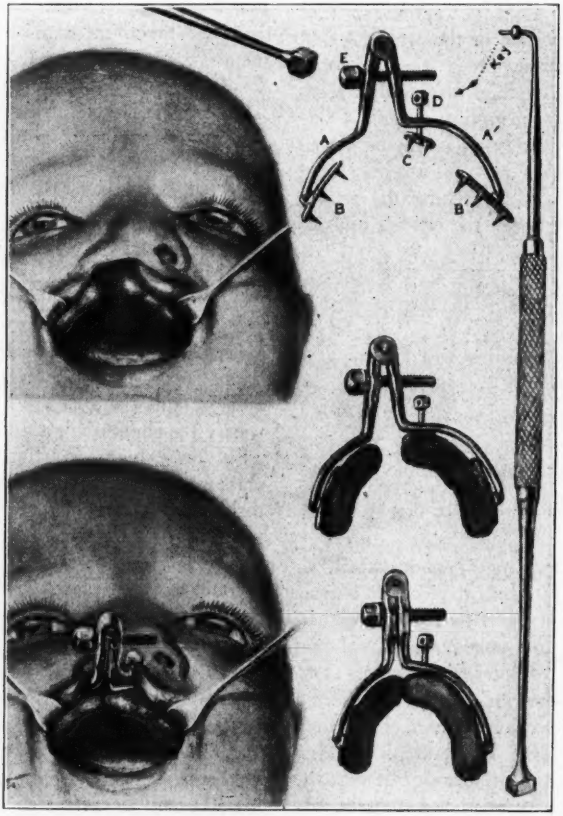

Fig. 2.—Schematic drawing illustrating clamp. Since this drawing was made, at the suggestion of Samuel J. Lewis, a spiral spring has been used between the head of screw *E* and arm *A*, which produces continuous gentle pressure.

The clamp may be used in clefts of either the left or right side as well as in double cleft palate. It is made of the finest tool steel, nickel plated, and triple

The advantages of the clamp illustrated and described are: 1. Only short, light anesthesia is necessary. 2. There is little or no shock. 3. There is only

slight tissue injury. 4. The developing tooth buds are not injured. 5. Nursing from the bottle is not interfered with. 6. The position of the clamp is not disturbed by movements of the facial muscles, as the arms of the clamp are so constructed that they protrude through the cleft of the lip. 7. The mouth can be kept absolutely clean. 8. The area can easily be inspected. 9. The bone changes that take place are of a physiologic rather than pathologic nature, owing to gentle continuous pressure.

TREATMENT OF ORAL CONDITIONS BY ULTRAVIOLET RADIATION

By MAX L. BRAMER, D.D.S., Wood River, Ill.

ONE of the main theories of life involves the action of the invisible rays of the solar spectrum. It has been proved beyond a doubt that without these rays of sunlight, there would be no life. In the last few years, the medical profession has done both research and actual work with these rays of the spectrum, both as an adjunct to cures in certain diseases and as a specific in many others, with wonderful results.

I wish to present a few case histories after two years of experimenting with actinic rays in the treatment of dental disorders. I started with a Kromeyer water cooled lamp, but discarded it because it emitted a nonpenetrating ray, which had a destructive action, with no constructive action; also because of the severe reaction, which consisted of a very marked swelling and blueness of the gums, with excruciating pain, lasting from two to five days.

Owing to these features of the treatment, although it was attended with some success from a dental standpoint, great persuasion was necessary to insure the patient's return for a second exposure. I therefore turned my attention to obtaining ultraviolet radiation which would have both a constructive and destructive ray. This I found in an open flame carbon arc lamp.

This lamp consists of an 8-inch reflector, parabolic in shape, with vertical carbon rods, with a focal point directly in front of the reflector and a conical adaptor tapering to an inch and a quarter opening. Inserted in this adaptor are a set of pyrex applicators designed for anterior, buccal, lingual and palatal applications.

Through experimentation, I have found that ultraviolet radiation has the following effects: (1) biologic; (2) bactericidal and (3) curative. The ultraviolet rays cause: (1) sedation; (2) regeneration; (3) stimulation; (4) oxidation; (5) sterilization and (6) analgesia. They have the following action on blood: (1) marked stimulation of phagocytosis; (2) decrease of abnormal blood pressure, and (3) increase of calcium, iron and phosphorus content. Other effects are: (1) increased metabolism, and (2) production of vitamin D.

REPORT OF CASES

CASE 1.—Miss A, aged 20, had a partially erupted third molar which had given severe pain for several days. Of the two other den-

tists seen, one had lanced the gum and the other had given sedatives; but neither afforded relief. I gave a ten-minute exposure with C carbons, and the patient slept well that night, with virtually no pain. No further treatment was necessary.

CASE 2.—Miss B, aged 19, had badly discolored anterior teeth. I isolated the teeth with a dam opened from the lingual aspect, surrounded them with peroxid solution, gave two ten-minute exposures on succeeding days, and bleached the central incisor to an almost normal color.

CASE 3.—Mrs. C, aged 40, presented a case of acute and chronic gingivitis and swollen gums which bled copiously, with severe pain, but no definite pyorrhea pockets. A dentist had scaled the teeth and applied a medicament, but relief lasted only a month or so. I gave ultraviolet radiation of increased exposure every other day for seven treatments, and the condition cleared up. Six months have elapsed with no recurrence.

CASE 4.—Mr. X, aged 35, had a severe case of pyorrhea. The anterior teeth were loose, there were numerous pockets of various depths, pus exuded and there was a marked degree of inflammation. I carefully scaled the teeth, and then employed the ultraviolet ray, increasing the exposure every other day for twenty treatments, at which time the gums were a healthy pink, there was no pus present and the teeth had tightened to a notable degree. I followed up this case, and six months later, roentgen-ray examination revealed definite regeneration of bone tissue. During the interval, there was no recurrence of the original condition.

CASE 5.—Mr. C came to my office with severe pain following extraction of a lower first molar. I found a dry socket with a great deal of necrosis. Ten minutes' exposure to the ultraviolet ray afforded almost instant relief.

CASE 6.—Mr. A, aged 25, had a well marked case of Vincent's infection, with fetid breath, phagadenic ulcers and a generally serious condition. Ultraviolet radiation was given and the oral tissues were painted with a 2 per cent solution of metaphen. The pain was relieved after the first exposure. I increased each exposure, giving one each day for five days. A complete cure was effected.

In all the cases treated, the reaction has been nothing more than an ordinary sunburn would occasion owing to the deep penetration of the carbon arc in contrast to the shallow penetration of the mercury arc. In many of the 100 cases treated, a definite cure has been effected. Marked improvement has been noted in all cases. Definite cures have been effected in pyorrhea, gingivitis, Vincent's infection, infectious stomatitis, peritonitis and postoperative pain. In pyorrhea cases, a definite regeneration of bone has resulted as has been proved by surgical and roentgen-ray examinations.

From these experiments and results, it seems to me a foregone conclusion that ultraviolet radiation will, in the near future, be a definite part of the equipment of the modern dentist.

SINUS DISEASE IN CHILDREN*

By T. C. Galloway, M.D., Evanston, Ill.

THE assumption is often made that the nasal accessory sinuses in children have not sufficiently developed to harbor infection, and the subject is dismissed as of no importance. It seems worthwhile, therefore, to recall some of the established facts in regard to these cavities and to point out the importance and frequency of their infection.

The incidence has been reported by Dean as 15 per cent in one series of cases of tonsillectomy, and 46 per cent in another series. Harke found that 14 per cent of the sinuses opened in 394 postmortems showed evidence of disease, and other observers have found from 16 to 50 per cent of infections in hospital or dispensary cases.

It seems to have been proved that the effect of such infections may be widespread, including persistent colds, bronchitis, bronchiectasis, pneumonia, asthma, arthritis, endocarditis, nephritis and nephrosis, pyelitis, otitis, orbital cellulitis, osteomyelitis of the bones of the face, mouth breathing with its train of effects, brain abscess and meningitis. That is, from sinuses in children infection may spread widely by continuity; or they may serve as true foci of infection with distant metastatic or toxemic effects. Amberg considers them, after tonsils and adenoids, the most important foci of infection in the earlier years.

The possibility of sinus disease in early life seems to be limited only by the degree of development of these cavities to a point where infection may be pocketed. Colet reports sinus infection at 1 month of age, and Dean has reported fatal disease at 2 months.

The maxillary antrum at birth is, according to Skillern, about the size and shape of a small bean, with its long axis anteroposteriorly. It grows, according to W. B. Davis, 2 mm. vertically and laterally and 3 mm. in length each year up to the ninth year, then more slowly until the fifteenth year, when its growth is nearly complete. In the new-born, the floor averages about 4 mm. above that of the nose, coming to lie on the same level about the eighth or ninth year.

The ethmoids are complete at birth and are relatively the most developed of the cells, but continue to expand and invade surrounding areas.

The most anterior or, as Davis believes, the most precocious grows up into the vertical plate of the frontal bone and forms the frontal sinus, which may be of important size by from the fifth to the seventh year.

The sphenoid is little more than an indentation on the body of the sphenoid bone before the second year, but by from the fifth to the eighth has extended back

*Read before the Section on Oral Surgery at the Midwinter Clinic of the Chicago Dental Society, January, 1928.

under the sella and become of clinical significance.

It must be remembered that there is great variation in the size and rate of development of the sinuses in children and even marked asymmetry in the same individual. Roughly, it may be said that the ethmoid and maxillary sinuses are of clinical importance at birth, the sphenoid at about from the fifth to the eighth year, and the frontal, from the fifth to the seventh year. Of these, the maxillary sinus probably most commonly suffers and is most markedly affected.

As to the etiology of sinus disease in children, the predisposing causes are, as in the adult, whatever interferes with aeration and drainage. Chief place must be given to diseased tonsils and adenoids, and Dean has reported a cure in more than 80 per cent by removal of the tonsils and adenoids without other measures. Important factors include acute infections, especially the exanthems, congenital syphilis, sensitization rhinitis with attendant swelling and blocking, metabolic disorders, with unhealthy boggy nasal mucous membranes, especially, according to Dean, that due to deficiency in the fat-soluble vitamin (A), the presence of foreign bodies and infection of teeth or tooth buds.

A wide variety of infecting microorganism have been found, including streptococci, those of the hemolytic variety being especially virulent, pneumococci, staphylococci, especially in the more chronic cases, *B. influenzae* and Klebs-Löffler *(Corynebacterium diphtheriae)* and meningococci. Certain epidemic strains seem to have a marked predilection for the sinuses.

The pathology differs little from that in the adult except that, since cases are not of long standing, there is not often irreparable damage to the ciliated epithelial lining on which normal function depends, and bone necrosis infrequently occurs. Dental disease is not commonly associated as cause or effect, though sinus empyema does occur secondary to infection of a tooth bud, and mouth breathing may result, with developmental defects. Since the lining is thicker and more vascular, with greater lymphatic drainage, metastases or distant effects have been more marked than in later life. Usually, more than one sinus is affected. At times, the sinus infection is only part of a process involving the tonsils, adenoids, nasal mucosa and possibly the eustachian tube and middle ear, in which it has no separate importance.

Symptoms in acute cases are those of severe infection and include nasal blocking, purulent or mucopurulent discharge, excoriation of the nares, constant or frequent colds in the head, cough, which may be paroxymal, headache or pain, infrequent under 5 years. Edema of the lids and epiphora may be present. Symptoms may also occur of an associated pathologic process in the ears, bronchi, lungs, kidneys, joints, heart, cranium or elsewhere. In acute cases, general symptoms may be marked. There may be little or no general effect in chronic cases. The patients are likely be morbid, pasty looking, restless and undernourished.

The diagnosis is made on the symptoms, the signs in the nose, transillumination, the roentgen-ray and diagnostic puncture. The discharge, which is thick, yellowish or greenish, if profuse and persistent is the basis for a presumptive diagnosis, and more so if produced by suction after preliminary clearing of the nasal chambers. Secretion in the nose will often be seen localized to correspond with the drainage of the affected sinus, with the bathed turbinal tissue

swollen and inflamed. Postnasal rhinoscopy and use of the nasapharyngoscope may add much information. Transillumination is of considerable value in older children when allowance is made for normal variation, but is worth little in infants. The roentgen-ray may be valuable and should be made before puncture or operation. Diagnostic puncture is simple and its evidence most conclusive, especially if plate culture is made of reaspirated salt solution and microscopic examination is made for pus cells. It may, indeed, be impossible to make more than a probable diagnosis, but the indications for treatment are usually clear.

Treatment includes, in the order named, astringents, especially diluted epinephrin or ephedrin to promote ventilation and drainage; suction; correction of bad dietary or hygienic conditions; removal of tonsils and adenoids if the sinusitis persists, especially as usually in such cases there are other reasons for so doing; puncture, which may at once put the normal mechanism in condition to master the disease, climatic change, and, lastly, operation.

Operation should be very conservative and should not be employed except as the last resort. It should be done with due regard for dental development and for the normal ossification centers of the growing bones, particularly of the maxilla. It must spare the tooth buds and involve no mutilation of the turbinates if possible. For the antra, a window under the infracted but intact inferior turbinate kept open by a rubber tube or careful postoperative attention is preferable. Dean and others have, in a few rare cases, considered radical operation necessary on the antrum through the canine fossa and have not hesitated to open the ethmoids and the sphenoids.

The most trying of these cases are those in which perforation is imminent or present or marked osteomyelitis occurs with perhaps damage to the tooth buds.

Most of these cases occur in relation to the orbit because the thin lamina papyracea, the os planum of the ethmoid, is easily injured. Edema of the lids and moderate thickening of the orbital tissues occur not infrequently but will probably subside with energetic intranasal treatment with astringents and suction. If sepsis is pronounced or if damage, which will quickly become irreparable, is being done to the eye as shown by marked bulging or fixation of the globe, dilatation of the pupil or blurring of the optic disk, immediate drainage is imperative. This should be conservative but adequate. In the orbit, entrance should be gained through a curvilinear incision through or below the brow, the ethmoids or frontal sinus entered and drain inserted. A small tube may be used. The orbital tissues, unlesss definitely invaded, should not be opened. More radical procedures should be avoided or postponed until general and local immunity to the infection develops. Usually, it is best to wait until a sequestrum forms, as this, I believe, gives the minimum damage and least interference with later development. It must be remembered that the young, vigorous tissues in children have great recuperative power and there are not the long standing changes which lead to chronicity in the adult. Around the antrum conservatism is also most advisable since damage to the numerous centers of ossification is most easy.

REPORT OF CASES

CASE 1.—K. L., a boy, aged 3½ years, seen with Dr. Herbert A. Potts in October, 1926, had had an abscessed tooth extracted three

weeks before. The left side of the face was greatly swollen. Pus drained through the socket of the upper left central incisor. There was bogginess over the maxilla up to the orbit and a dense shadow over the left antrum, with roentgen-ray findings not definite for pathologic change. Creamy pus was present in the left middle meatus. I washed the antrum through the inferior meatus by puncture, finding a fair amount of clumped mucopus in the antrum. Dr. Potts uncovered the area of alveolar involvement and drained it. After one month, he removed a damaged tooth bud and a thin sequestrum running nearly to the orbital margin. Except for the loss of one permanent tooth, no damage seemed to have been done here, and Dr. Potts' conduct of this case taught me a valuable lesson in conservatism.

CASE 2.—*History and Examination.*—H. S., a girl, aged 12 years, admitted to the Evanston Hospital March 15, 1925, and first seen by me four days after admission, was very toxic and semi-delirious, with a temperature of 104, with no remission; pulse, 120; respiration, 25. The turbinates were very boggy, water-logged and bathed in thin mucopus and the left nostril was completely blocked. The left lid was markedly swollen, the left eye pushed forward and mobility moderately impaired. The next day, the left pupil was widely dilated and did not react, and the globe was almost immobile. Vision was reduced to shadow perception. The patient was irrational and weak. The temperature was 105.

Operation.—Under nitrous oxid-oxygen, a crescentic incision was made through the lower one-half of the brow line and below the inner canthus, and the periosteum elevated. The ethmoid cells were broken down by a curette and a dehiscence found about 2.5 cm. back from the internal canthus. The orbital wall anterior to this was removed and the periosteum incised at the posterior end of this era. A small amount of serosanguineous fluid escaped from the orbit. Through and through (from the wound to the anterior nares) rubber drainage was left in. The general condition immediately improved. The temperature fell rapidly, and in two days the patient could see costume details and the eye movements were nearly normal. The tube was removed on the twenty-fifth day, and the wound closed two weeks later.

July 22, the wound was tender and so was reopened. A sequestrum of the floor of the frontal sinus 1.3 by 0.8 cm. was removed, after which healing was rapid. The patient was discharged May 7. A moderately depressed scar remains. The first operation might well have been less extensive.

CASE 3. C. R., a girl, aged 3 years, one year previously had had a swelling below the right eye, laterally to the lacrimal bone and not involving the tear duct. The turbinates on the right were so swollen that drainage from the middle meatus was blocked. The external swelling was red, tender and localized. Incision over it gave thick, yellow pus. The antrum was drained through the inferior meatus. A small tube was left in place and the antrum quickly cleared up. No attempt was made at this time to remove the dead bone, but the external wound was left open until a small sequestrum separated, seven weeks later. Healing followed shortly, and now, after one year, there is no perceptible deformity and almost no visible scar. This result could not have been obtained if the temptation had been followed to excise the diseased bone radically, with almost certain interference with development. It took much forbearance on the part of the child's parents and myself to withstand the pressure from well intentioned friends for quick action, but the final result surely justified conservatism here.

Many cases related to a systemic condition might be cited, but they are perhaps not so pertinent to this discussion, which has not attempted to be exhaustive. It is hoped that an impression has been given of the real importance of sinus infections in children which (1) are frequent; (2) may have important local and distant effects, and (3) may be cured by appropriate treatment, which should be the most conservative to gain this end.

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UNSEEN FORCES IN ORTHODONTIA*

By ROBERT H. W. STRANG, M.D., D.D.S., Bridgeport, Conn.

THE subject "Unseen Forces in Orthodontia" brings forward for discussion problems that are fundamental. For the purpose of study, the topic will be considered under three main headings; (1) unseen biologic forces; (2) unseen physiologic forces, and (3) unseen mechanical forces.

UNSEEN BIOLOGIC FORCES

(a) The Law of the "Line of Occlusion."—More than twenty years ago, Edward H. Angle advanced the greatest concept that was ever introduced into the theory of orthodontia. I refer to his idea of the "line of occlusion," which was defined at that time as "the line with which, in form and position, according to type, the teeth must be in harmony if in normal occlusion." The biologic depth of this law, which was clear to the originator, was not recognized until quite recently, when the broadness of this vision at last was appreciated and its truth accepted.

It is agreed among biologists that, from the fertilized ovum, there will be evolved an individual whose general architectural form and relation of parts is preconceived at the time the male and female pronuclei unite. This means that there is just a grain of truth in the preformation theory of the older generation of scientists, which advanced the belief that the individual was in the ovum *in toto* from the start, but in miniature, and that each part simply grew larger until adult size was reached. This concept was exploded when the microscope revealed just what was going on in the fertilized germ cell. More recent studies have taught us that a being of specified architectural form, with all parts in harmony and balance, is really predetermined, when male and female gametes unite, and that such an individual will be evolved provided suitable building material is furnished and the cell workers are permitted to do their part unhampered by unfavorable environmental influences. In order that there shall be harmony among the various individual parts, each must conform to the specifications of the general building plan. There is, therefore, a carefully selected position in the "space" of the individual for his denture and each unit of this organ is designed to fit into its predetermined location so that, in the assembling of the whole, there will be this perfect balance. Consequently, one of the greatest of the unseen forces in orthodontia is this inherent cell intelligence, placed there by the Master Builder, which battles against the greatest of odds in a persistent effort to mold each part in harmony with the architectural plan for the body. The organ of mastication, consisting of the teeth, peridental membrane, alveolar processes, maxillary and mandibular bases and

*Read before the Section on Orthodontia at the Midwinter Clinic of the Chicago Dental Society, Jan. 25, 1928.

the supporting osseous bulwarks of these two bones, the muscles and overlying soft tissues, is built by its cells to meet the requirements of these plans, and the "line of occlusion," as we think of it today, is that part of this general preconceived architectural plan that pertains to the position and relation of the organ of mastication. It is the biologic interpretation of the unfolding of the denture in the life history of the individual.

(b) The Power of Heredity.—It was not so many years ago that all cases of malocclusion whose etiology was at all obscure were classified as inherited deformities, and malpositions of the teeth of the parents or the large teeth of one parent and the small jaws of the other were brought forward as proof of the correctness of this point of view. The unscientific foundation upon which such deductions were built produced a reaction that was radical in the other extreme, and the forces of heredity were excused as having nothing at all to do with the etiology of malocclusion. Both of these attitudes seem to be rather irrational, and therefore it is necessary for us to consider this question in the light of present-day knowledge.

Among the early differentiation of cells coming from the dividing ovum are two important groups. These are the somatic, or body building, cells and the germ cells, or guardians, custodians and passers on of the unit characters of the species of which this individual is but one expression and which are loaned, for the time being, as it were, to the person in whom the germ cells are temporarily residing. That which is passed on to the next generation is in these germ cells, the composition of which, in the form of so-called unit characters, is fixed and determined at the time of fertilization of the ovum from which this being was evolved. But all the material that is to visualize this one particular individual is in the somatic cell group. Deformities, as malocclusion, are failures in somatic cell unfolding, occurring years after the makeup of the germ cells of the one in whom these defects are seen. Hence, not being in or of the germ cells, these body malformations cannot be passed on to the next generation. Such is the teaching of the modern biologist.

On the other hand, certain combinations of germ plasm, certain unit characters passed on in the so-called genes, which are the conveyors of inherited characters and component parts of the chromosomes found in the cell nuclei, coming half from the paternal strain and half from the maternal line, may determine a somatic expression in tissue form and peculiarity that is more susceptible, or even encouraging, to conditions which lead on to malocclusion. We know that some children are more susceptible to sickness than others; that some are strong; while others are weaklings; some have stable nervous systems, while others have nervous systems that are easily unbalanced. Yet, given proper environment, all of these children might evolve into fairly normal adults because of that inherent property of life and living things, that unwritten law of protoplasm, that forces it to try to build the ideal and the perfect as dictated by the demands of function.

But the modes, customs and methods of present-day civilization have placed new obstacles in the path of these fundamental laws of Nature. In the old days of the "survival of the fittest," only the strong and hardy and those best suited to combat the impediments of environment were preserved to propa-

gate. Now, the highest of intellects, the millions of philanthropists, the devotion of parents, are all united in an effort to prevent the weakling from falling a victim of Nature's rule. Defective in body and unstable in nervous poise, he reaches adolescence. Still this is not enough. He is allowed to propagate his kind without stint or control. His mate, in turn, is apt to be of a degenerating type. Hence, the germ cells of these two individuals are carrying unit characters that are increasingly less resistant to any environmental influences that hinder normal growth and development.

The nervous system is the most sensative to surroundings of all the parts of the body. It was evolved, primarily, to keep the organism in touch with its mediums of contact and to govern body functions to meet the demands of environmental changes. This is of particular interest to us because the outward expression of nervous reaction of the higher centers comes through the facial muscles. These structures begin their activity immediately after the new being enters the world. The baby crys, laughs and suckles. His nervous system is susceptible to irritations and he expresses the knowledge of these through his facial muscles. In the normal child, such expressions are followed by periods of relaxation, and there is complete repose of muscle tissue at normal muscular tonus. Not so with the child having as his heritage a nervous system that is of the "hair-trigger" type. Such a tissue organization is constantly discharging impulses which keep the muscles of expression in continuous action. These facial contortions organize themselves into so-called habit spasms and become an integral part of the child's life. Thus, the balance of forces exerted on the growing organ of mastication is upset, and malocclusion is evolved.

I was recently in contact with a group of children ranging from 5 to 7 years of age, and the universal twitching and habit contortion of the muscles in the region of the mouth were appalling. The most pronounced case of all was in a little fellow whose family history is of interest. He was in almost continuous spasm, in face, arms and legs. It was not chorea, but closely approached it. Now his mother is possessed of a nervous system that is unstable. Her two brothers are great facial contortionists. The boy's father is of the same type. The maternal grandmother is neurotic. The grandson was destined to be susceptible to nervous instability by virtue of this tissue peculiarity. Had he been turned out doors and made to live as close to nature as possible, he might have developed a fairly normal

Fig. 1.—Hypertonus of the facial muscles in the region of the oral cavity.

Fig. 2.—Hypertonus of the facial muscles. The mouth has a "set" expression.

body with reasonably quiet musculature. But under the irritation of the routine of the wealthy, civilized child, he was bound to break. It is most reasonable to predict that it will not be long before radical interference by an orthodontist will be indicated if severe deformity is to be averted, but, may I add, the prognosis in such a case is exceedingly unfavorable for a stabilized result.

Do not get the idea that I am saying that such children inherit a nervous system that is lacking anatomically, histologically or physiologically. That would be akin to stating that they inherited an acquired deformity, which, we have previously stated, cannot be the case. The fact that I wish to convey is that they inherit a type of nervous system that is very susceptible to breaking away from normal action under certain unfavorable environmental pressure.

Fig. 3.—Hypotonus of the facial muscles.

If this is so with the nervous system, it is equally so with the osseous, muscular and other systems. The same environmental influences that produce no injurious effect on bone formation in some children may result in rickets in others. Why? Partly because the heritage of each child is different, even in brothers and sisters. We now know that the same combinations of unit characters in the chromosomes of the germ cells of the same individual probably never take place because of the shuffling that occurs during the processes of synapsis and maturation when these cells are prepared for fertilization. Thus, the heritage of each individual, even though of the same parents, is made different. That is why variation is omnipresent, even in families. It is the reason that some children are more susceptible to disease and deformities than others. It is one of the answers to the great difference in the mental, physical and moral qualities of the component units of families and species. Hence, we find sufficient scientific foundation for stating that the unseen force of heredity plays an exceedingly important rôle in the field of orthodontia.

(c) Growth.—The hidden force of growth is so fundamental and obvious

Fig. 4.—Hypotonus, undergrowth and underdevelopment (upper lip) of the muscles of the face.

that we will not take the time to discuss it other than to give expression to the opinion that this is the great power that impels protoplasm to strive its hardest to meet the requirements of the architectural plan of the individual.

(d) Development.—This may be differentiated from growth by viewing it in the light of tissue specialization and modification with a view toward more perfect adaptation to function. Growth and development, as tissue's characteristics, are often used interchangeably, but they are not synonymous terms.

Developmental force is also an unseen factor that contributes much toward evolving a normal organ of mastication. Any orthodontist who has pondered long and deeply over tissue phenomena has come to realize that his sole object in treatment is but to bring back into working order, and maintain in this state, these two wonderful, unseen forces of cell protoplasm, growth and development. His mechanical interference simply bridges over and atones for that period in the individual's history when these two factors were so antagonized that they built and evolved faulty tissue form. The orthodontist overpowers and attempts to eliminate these disturbing

Fig. 5.—Hypertrophy of the mentalis muscle. There is excessive development of the tissues in the region of the chin. The lower lips rolls over and protrudes.

elements; he restores, to as great an extent as possible, normality of form and position, and then depends on these two forces to complete their unfinished task under re-established, favorable circumstances.

UNSEEN PHYSIOLOGIC FORCES

Function is the great dictator of tissue form and modification. Nature is constantly trying to better adapt herself to the demands of this impelling force. Nowhere else in the body can such changes in form be better demonstrated than in the structures comprising the organ of mastication. The history of the evolution of the teeth from the dermal scale and primitive cone to the multicusped and complicated molars of the higher mammals is evidence of the influence of function on tissue form. The arrangement of the fibers of the peridental membrane, the lamellae and trabeculae of the alveolar process, the form and support of the basal bones and the adjustment and action of the muscular masses active in the movement of the associated parts all have function as their great dictator.

But does this harmonize with our previous statement that there was a predetermined architectural plan, and that Nature built to this? It certainly does

Fig. 6.—Hypertrophy of the mentalis muscle combined with undergrowth and underdevelopment of the upper lip.

because this plan takes into consideration the demands that function will place on these various structures, and the interrelationship is so intimate that the plan cannot be perfectly unfolded without the help of the forces of function. In other words, perfection of growth and development is subservient to this third unseen force, i. e., function.

Just as surely as normal functional forces will mold tissues into correct form and thus complete the designated plan for the body and denture, so will perverted functional energy produce errors in growth and development which mean deformities, including those of malocclusion.

The greatest functional force exerted on bones and teeth is that of muscular action; consequently, one of the greatest producers of bony malformations and malocclusion is the hidden action of muscular tissue working in a perverted and abnormal manner. The upper teeth are suspended and the lower ones elevated into masses of muscular tissue. A balanced action in these various groups on either side of the teeth is absolutely imperative if we are to have stability of form in the dental arches. Such harmony is frequently disturbed; hence, an analysis of the various states in which we may find this tissue is of interest.

Muscles, under normal conditions, are in a state of tension, called muscle tonus. Physiologists look on this as somewhat different from muscle contraction but have not been able as yet to explain it clearly. It is said to be neurogenic rather than myogenic in origin. From Howells' "Text Book of Physiology," we quote the following:

> Its cause lies in the nervous system and not in the muscle itself. Furthermore, the impulse causing it does not arise automatically in the nerve center but comes from the action of a sensory impulse. It is a reflex phenomenon. It may be excited by emotional and intellectual activity, sensations coming from the higher centers; or the cutaneous nerves may be the conveyors of sensory impulses that cause variation in muscular tonus. It is seen in all muscles.

Its importance is emphasized in connection with equilibrium; in maintaining pressure against the abdominal contents; and in blood vessel, intestinal and visceral tonus. I would also call attention to its great importance in furnishing proper support to the component parts of the dental arch, for the purpose of guiding these into correct position in the "line of occlusion," as well as maintaining them thus thereafter. This is an unseen force of great influence about which little has been written.

If muscle tonus is concerned in directing and stabilizing normal tooth position, any prolonged departure of normal tonus in these muscles should be accompanied by faulty tooth placement. This unquestionably is true. There are two variations in muscular tonus: hypertonus and hypotonus.

Hypertonus of the Facial Muscles.—Diagnosis of this condition is made by observation and palpation. The former shows a somewhat "set" facial appearance, such as would suggest obstinacy or determination. There is a "hard" expression about the mouth. (Figs. 1-2.) Palpation elicits a tenseness of the tissues that is very characteristic. There is no resiliency or stretch to them. "Boardlike" is the term that best describes the condition. The malocclusion accompanying hypertonus shows an arch that has been molded and evolved under intense pressure labially and buccally. It is usually a Class I deformity with the molars and bicuspids of both sides, upper and lower, mesially to normal skull relationship. The upper and lower incisors have been held in a lingual position to the "line of occlusion" and are rotated, while the upper cuspids are badly displaced labially with their crowns much farther mesially than their root apices. Often, the space for these teeth has been completely obliterated by an approximation of the lateral incisors and the first bicuspids. On the lower arch, the cuspids are not displaced so far labially because they usually erupt before their arch space has been closed, or they may overpower the lateral incisors and crowd these lingually. Their crowns are badly tipped mesially by the forward movement of the lateral portions of the arch. Hypertonus is often accompanied

by other muscle perversions which must be taken into careful consideration when analyzing the effect on tooth position and considering the prognosis of the case in question.

Hypotonus of the Facial Muscles.—This is a condition of the muscle in which it has lost tension. (Figs. 3-4.) It is flaccid and limp when at rest, a state well illustrated by the condition of the muscles of the lower lip of a mouth breather. Such muscles appear enlarged but are probably simply bulky because of this relaxed tonus. Hypotonus does not deform because of the action of a hidden force, but rather by a failure to support the teeth properly or because of the presence of excessive bulk, which acts as a foreign body.

There are also several myogenic conditions of muscles that must be considered in a complete survey of our subject. These are hypertrophy, atrophy, undergrowth and underdevelopment and spasms, or tics.

Hypertrophy is a condition in which there is an actual increase in the amount of muscle substance. It is due to excessive use and is not an uncommon condition. In the muscles about the mouth, it is probably most frequently seen in the mentalis, that muscle that raises the lower lip and causes it to protrude, pulling up the skin over the chin. In these cases, it will be noted that it is very difficult to force the lower lip away from the incisors. This lip is thick and protrudes and the skin over the chin shows heavy wrinkling because the muscle is quickly and easily thrown into spasmodic contraction when the lip is touched. (Figs. 5-6.) It is readily differentiated from hypertonus because, in the latter, the feeling is one of a nonactive muscle. This hypertrophied muscle gives rise to an unseen force that displaces the lower incisors lingually and the upper incisors either lingually or labially, this depending on which surface of these teeth it is in contact with. The prognosis in this condition is exceedingly unfavorable, for it is quite impossible to reduce muscle size without producing tissue degeneration, which, in turn, is about as serious a condition as the original hypertrophy.

Atrophy, in the true sense of the term, rarely presents itself to the orthodontist. To be in this state, a muscle must first grow and develop to nearly normal size, and then, from lack of use or disease, wither away and degenerate. This might happen in facial paralysis or in traumatic disturbance of the nerve supply to some of the muscles.

Undergrowth and underdevelopment are conditions that are frequently met with. As has been previously suggested, the inherent force of growth depends on the stimulating effect of function to bring out its highest degree of activity. Normal development, on the other hand, relies on both growth and function to aid in the completion of its task. Hence, muscles that do not function properly are usually both undergrown and underdeveloped. We see this illustrated in the short upper lip of the mouth breather. (Figs. 4-6.) It is undergrown because it has not functioned, and it is underdeveloped because it has neither grown or functioned normally. The malocclusion that muscles in these states are responsible for is due to lack of tooth and tissue support in the required locations and abnormal pressure on oral structures in unexpected positions. However, the prognosis in this type of muscle change is much more favorable than in any other because it is possible to start activity by the use of exercises, and if these are continued systematically and this

artificial functioning maintained consistently, the muscle will again take on growth and development and thus be made to approximate its normal size and degree of action.

As habit spasms have received much attention in orthodontic literature, I shall discuss them only from an anatomic angle, thus attempting to interpret the malocclusion that is the visible expression of their subtle and powerful forces. For a long time, I have been particularly interested in the malocclusion that shows a bilateral mesial shifting of the sides of the dental arches. This is a deformity that is certainly more prevalent today than in the years gone by. It is due, almost invariably, to an insiduous muscle perversion that brings into play the buccinator, temporal, internal pterygoid, and deep portion of the masseter muscles. It is primarily a sucking habit, attaching itself to the first stage of swallowing, when the child is seen to gather the saliva together, as it were, by creating a vacuum in the mouth. This, of course, is done thousands of times a day. The first effect is a narrowing of the two arches. Teeth react to abnormal pressure by not only moving in the exact direction dictated by this force but also in any other way that will afford relief. The secondary change, in this case, is almost invariably expressed in a mesial shifting which is due in part to the pressure of the buccal tissues and also in part to a force exerted directly on the distal ends of the arches. A study of the cause of the latter pressure is of interest.

We have been taught that the lower arch is supported distally by the dense bone at the inferior end of the anterior border of the ramus of the mandible and that the upper arch is sustained, in turn, from distal displacement by the interlocking of the cusps in occlusion. But study of the anatomy of the parts reveals a better and more substantial source of support than this. There is a thickened portion of the buccopharyngeal membrane that runs from the hamular process of the sphenoid bone to the posterior end of the mylohyoid ridge of the mandible, known as the pterygomandibular raphé. From this arises the central fibers of the buccinator muscle, which, as they blend with those that come from the buccal aspect of the alveolar processes of the maxilla and mandible in the region of the molar teeth, swing around from behind the last molars, upper and lower, and run forward, to be eventually lost in the fibers of the orbicularis oris. It is this muscle, then, that by virtue of its particular point of attachment, supports the posterior ends of the dental arches. For the same reason, when it becomes active in a habit spasm such as sucking, it forces the lateral segments of the arches mesially. In this perversion, it is aided by the fibers of the temporal muscle that are inserted into the anterior border of the ramus as far down as the last molar tooth, by the internal pterygoid, which is inserted into the internal aspect of the ramus below the mylohyoid ridge and by the fibers of the deep portion of the masseter muscle that run from the zygomatic process of the temporal bone above, to the external aspect of the upper part of the ramus and coronoid process of the mandible below.

Another group of muscle dictators is composed of those that are inserted into the orbicularis oris near the corner of the mouth. These are the zygomatic head of the quadratus labii superioris, the zygomaticus and caninus, coming from above; the buccinator and risorius, approaching from the side, and the tri-

angularis and quadratus labii inferioris, entering from below. Most of the narrowing in the cuspid region of the lower arch is due to the unseen force arising in this group and acting in habit spasm. Whenever, after retention has been removed, you note a well-rounded and symmetrical lower arch beginning to collapse in the cuspid and first bicuspid area and rotation of the incisors showing itself, watch for excessive muscular contractions of this set of tissues. Many cases said to be affected by the eruption of the third molars are really suffering from such excessive muscular pressure.

But behind these muscular perversions, there is an unseen force that is so baffling that no one as yet has been able to trap it. I refer to the cause of the upset nervous balance of which these muscle states are but symptoms. This is the real fundamental factor that must be unraveled before the best service can be rendered in these cases. At present, we know so little about it that it is obsolutely undiscussible.

UNSEEN MECHANICAL FORCES

It was the mechanical aspect of the field of orthodontia that first held the attention of the dental profession and, for a long time, overbalanced the scientific and theoretical sides of the specialty. Within the last few years, there has been a tendency to emphasize the biologic and physiologic problems with such concentration that the mechanical and technical features have, in turn, been thrust into the background. This has resulted in a mild form of technical degeneration, which is unfortunate. The skilled orthodontist must be equally well versed in theory and mechanics; hence, a discussion of the unseen forces of mechanical origin is not only appropriate to the subject at hand but also extremely important and practical.

The treatment of malocclusion is almost universally affected by the use of appliances attached to or resting against the teeth. These devices are applied because they contain within themselves, certain hidden forces that may be directed by the skilled operator in such a manner as to produce the desired tooth movements. A careful analysis of these forces must be made if the full capabilities of any particular appliance are to be utilized. Furthermore, it is extremely important to know whether such a mechanism has hidden within its component parts all of the forces necessary to reduce the malocclusion under study.

This discussion is not put forth as a plea for the use of any particular type of appliance, but rather as an argument in favor of choosing a mechanism that is efficient in all details. Of what use is the most careful and correct analysis of a case of oral deformity or the proper planning of its treatment and retention if the orthodontist selects a device for tooth movement that is defective either in the ability to furnish the kind of power required or in the means of applying it to the teeth. This is a practical question, for far too many operators are attempting to treat complicated cases with appliances that are capable of producing only the most simple of tooth movements.

We know that individual teeth may be found in any one of seven positions of malocclusion or in various combinations of these seven. These are labial or buccal occlusion, lingual, mesial, distal or torsal occlusion, supraclusion and infraclusion. Furthermore, there may be considerable perversion of the normal axial relation of the crown to the root which it is absolutely necessary to re-

duce if treatment is to be a success. In surgery, we have operations somewhat empirically classified as minor and major procedures, and so, in orthodontia, we can group our type of tooth movements into minor and major classes. The simple alinement of the tooth crowns without any attempt to correct the faulty axial malposition by root movement, without an effort to establish the correct overbite through tooth elongation or depression, or without readjusting the normal mesiodistal arch relationship through extensive mesial and distal shifting of the teeth through the alveolar process may be said to be minor orthodontia. It is the orthodontia that has been practiced since teeth first underwent "straightening," as it was called. Some of the results of such orthodontia have been excellent because this treatment at times fully meets the requirements of tooth movement, but a large percentage of these cases have been a disappointment owing to the failure to correct teeth with faulty root inclinations or in extensive malposition. Modern orthodontia demands something better than this. Complicated malocclusion can be reduced in almost every detail if the proper technic is used; hence, it does not seem unreasonable to expect every operator who poses as a specialist to have under his complete control those appliances that are qualified to perform all intricate and delicate tooth transposition.

Let us now analyze the unseen forces in the various appliances in most common use and familiarize ourselves with the capabilities of each.

(a) The Round Labial Arch.—In this appliance, we find the lever, the spring and the jackscrew. By virtue of the forces that these three machines give forth, in conjunction with mechanical attachments on the teeth and devices connecting the two, we can move tooth crowns labially or buccally, lingually, mesially, distally and torsally. Teeth can be readily elongated, but depression is practically impossible to accomplish.

(b) Round Lingual Arch.—The unseen forces wrapped up in this device are limited to the lever and the spring. These can be used to move teeth labially or buccally, lingually, torsally, and mesially and distally, though the two latter changes can be made only when spaces have been provided by the loss or absence of juxtaposed teeth. The distal shifting of molars, followed in succession by that of the bicuspids and cuspids, cannot be accomplished. Teeth can also be elevated, but they can be depressed but little, if at all.

(a) Removable Spring Appliance.—The mechanical forces lying hidden in this mechanism are also those of the spring and lever, but they are applicable from an unstable anchorage and their effect is variable and uncertain. Nevertheless, they are present and can produce tooth movements of a limited character if applied to the teeth for a sufficient length of time.

(d) The Pin and Tube Appliance.—In this device are found possibilities for all of the tooth movements attributed to the labial round arch, except that the mesial and distal shifting of teeth attached to the arch is rendered more complicated by the nature of the attachment. But, in addition to the capabilities before mentioned is the force of the lever and spring, made applicable to the movement of the tooth roots, so that changes in the axial position of teeth can be brought about. This is an exceedingly important addition to the qualities of an appliance and makes possible the complete correction of certain cases of malocclusion which before could not be

satisfactorily handled. Changes in the position of tooth roots, unquestionably a more serious type of tooth movement than mere crown shifting, are included in the realm of major orthodontia. It requires expert technical skill in appliance manipulation and a thorough knowledge of the anatomy and histology of the parts operated on. The resorption of the alveolar process on the labial side of the roots was the first cause for alarm in the use of these root-moving appliances but care and skill soon taught the trained operator to avoid faulty tooth movements in these cases, and to be exceedingly careful not to cause excessive labial root movement in older cases, and thus this danger was avoided. Recently, considerable furor was raised by Dr. Ketcham's paper in which he calls attention to the great number of cases of root resorption in mouths in which teeth have been moved bodily. Although his deductions are open to criticism because we know that many tooth roots are resorbed even when there has been no orthodontic interference, his paper has performed an important service in pointing out another danger in major orthodontic procedure, and this condition will now be studied with the object of learning just why these phenomena have occurred. I have found this condition appearing in some of my cases; but in each of these, there has been sufficient reason along the line of violated physiologic processes to produce just this result. Extensive bodily tooth shifting, performed within the limits of Nature's laws, caused no apparent tooth or bone resorption; hence it seems safe and reasonable to state that this condition can be avoided by the proper use of the forces at hand, just as root denudation can and is being prevented. Let us also remember that there is nothing pathologic about a resorbed root; there are no inflammatory reactions connected with it. Probably, the life history and longevity of the tooth is not seriously affected unless the resorption has extended tremendously far. When we consider how firm a deciduous tooth is even when the roots are almost gone, we would hardly expect to find any clinical evidence of this condition in these moderately affected cases, such as tooth loosening or displacement. Furthermore, let us remember that practically all major surgical operations were formerly attended with much higher percentages of mortality than at present. Perfected technic and greater skill have reduced the danger. So will it be with these more complicated adjustments in our own field. Tooth roots must be moved, and hence we are forced to learn how to do this safely and well.

(d) The Ribbon Arch Mechanism.—With this appliance, tooth crowns and roots can be moved in all the required directions just as with the pin and tube device, but rotations and mesial and distal changes are more easily cared for. Depressions of individual teeth or groups of teeth can be successfully accomplished by virtue of the perfect transfer of force from arch to tooth. Furthermore, this appliance offers a new unseen force that is exceedingly helpful and useful when mastered and yet baffling and destructive in the hands of the ignorant. This is the torque force or force obtained by twisting a wire on itself. It is useful in moving roots and crowns, in obtaining stationary anchorage and in aiding in the elongation and depression of the molar teeth.

Thus, an analysis of the hidden forces in the various appliances in common use shows us that there are more unseen activities in some of these than in others.

Furthermore, the methods of transferring forces from their source of origin to the tooth to be acted on is more perfect and conducive to less error and loss of power in some than in others. Hence, this necessarily places a challenge before every orthodontist, if he is at all conscientious in his efforts. Having first analyzed his case carefully and ascertained all of the tooth movements demanded for the reduction to normal, he must then either use an appliance that can deliver the required forces or frankly tell the parent or patient that he cannot properly treat such a type of tooth displacement.

In a conversation concerning a transferred case in which we were mutually concerned, a brother orthodontist said to me, after ascertaining that progress was being made, "I frankly told the father that I had gone as far as I could, but of course I know that you can get results with the appliance that you are using." Now this man was honest with his patient and it illustrates to a nicety just the point that I wish to bring out. We must either limit our treatment to those cases that are adapted to the mechanism with which we are familiar or must learn to use an appliance that will meet the requirements of treatment. Any other attitude is courting failure, is unfair to the patient and parent and is opening an avenue whereby just criticism may fall on our specialty.

The unseen forces in orthodontia are friendly, helpful, subtle and treacherous. Idealistic nature, working through a wonderful cell cooperation, is ever striving to aid us, but the environmental influence and methods of present-day life have so burdened and antagonized these natural forces that many have been weakened and others made harmful. The greatest task that now confronts the orthodontist is to ascertain the fundamental causes of this weakening and perversion; for it is only by solving such a mystery that preventive orthodontia can come into its own. One of the most unsatisfactory phases of the practice of our science lies in the realization that we can do very little to check an oncoming case of malocclusion except by mechanical interference. We are unable to take charge of an infant and, by directing his course of living, force him to produce a normal organ of mastication. Although we know that these hidden forces are at work in every child's mouth, we are powerless to establish and maintain in full action those that are helpful and prevent or eliminate those that are harmful. This is a problem that some day we hope will be solved. It is a challenge to the orthodontist of the future, and only after he has met and conquered this will our specialty be able to render the greatest service to childhood and humanity that is within its scope and possibilities.

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DISCUSSION

Frederick B. Noyes, Chicago, Ill.: Dr. Strang's paper is tempered and judicial rather than argumentative. It invites to the consideration of principles and fundamentals rather than to the discussion of details. Orthodontia is a biologic problem which involves all of the relation of mechanical force to growth form, and that leads us far into the most difficult fields of biologic thought. In the first section of the paper, Dr. Strang has reviewed the fundamental conceptions of heredity as related to the development of bodily form and consequently as related to orthodontia. This has led him to a discussion of "the line of occlusion." Those who think only in terms of the concrete and the detailed will never grasp this meaning of "the line of occlusion," which is the greatest, the most far-reaching generalization in orthodontia. To concrete thinkers, it is vague, indefinite

or absurd, but that is only because they cannot follow from the consideration of the concrete and individual to the general and the abstract. The single, fundamental law cannot be visualized because the attention is focused, one by one, on the multitude of individual instances from which it must be formulated. In the second part of the paper, Dr. Strang discusses the unseen forces of function generated by muscular action, as related to normal and abnormal development of the denture. In this, several new and important factors are brought out. I will refer only to the action of the buccinator and other muscles in forcing the lateral halves of the arch, mesially. Orthodontia will always have its mechanical side, the importance of which no one should depreciate or lose sight of; but orthodontia is far more than the movement of the teeth by mechanical appliances. This section of the paper invites one to repeat the statement that, in the last analysis, the problem of the orthodontist is "the establishment of a normal balance of functional forces." The study of a case becomes, then, not simply the study of the positions of the malposed teeth and the means of moving them, but the study of the individual as a biologic entity. Finally, the third section considers the unseen forces generated by mechanical appliances. Force is invisible and all forces are visualized only by their effect. I commend this section of the paper to your thoughtful consideration. It is unbiased, analytic and fundamental, and most thoughtfully considers the forces that are generated by various types of appliances. It would be easy to lead off into the consideration of details, in the discussion of this paper, but that would be unfortunate, for it would only divert the attention from its fundamental character. I commend it to your thoughtful reading after it is published, and to your repeated study.

The Journal of the American Dental Association

58 East Washington St., Chicago, Illinois

C. N. JOHNSON, Editor

Published by the American Dental Association

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Editorials

THE MINNEAPOLIS MEETING

The 1928 meeting of the American Dental Association is now history. In many ways, it was outstanding. The attendance was exceptionally good; the weather was favorable, and the Local Arrangements Committee outdid themselves in the details of preparation. Every one to a man was available at all hours of the day and night to minister to the needs and comforts of the members. The Association will forever be indebted to these men for their service at this meeting. Not the least of their many courtesies was the entertainment provided for the ladies attending the meeting, at one function of which there were more than 2,000 in attendance.

The House of Delegates passed some very important legislation. A redistricting for the selection of trustees was passed, making thirteen districts instead of nine, as had formerly existed.

The men now on the Board under the new arrangement are as follows: W. O. Talbot of Texas, Charles M. Benbrook of California, Edward H. Bruening of Nebraska, Frederick H. Lum, Jr., of New Jersey, Sheppard W. Foster of Georgia, Harold S. Smith of Illinois, John F. Stephan of Ohio, Frank T. Taylor of Massachusetts, Harvey J. Burkhart of New York, John J. Wright of Wisconsin, George B. Winter of Missouri, C. E. Rudolph of Minnesota and R. E. Denny of Pennsylvania. Of these, the first eight were on the previous board and the last five were elected at the 1928 meeting. The four officers, the President, President Elect, Secretary and Treasurer are the ex-officio members of the board without a vote.

The opening of the session at the first general meeting Tuesday morning was very impressive. The Governor of Minnesota graced the occasion and made a most excellent talk. The address of Roscoe H. Volland, President of the Association, will be found in this issue and amply speaks for itself. It should be read by every one of our members.

The second general meeting, on Tuesday evening, was addressed by Glenn Frank, president of the University of Wisconsin, whose scholarly presentation of his subject held his audience to the end.

The third general meeting was held on Wednesday night and had for its speaker Charles H. Mayo, M. D., of the Mayo Clinic, Rochester, Minn., who was introduced by Senator Henrik Shipstead. Dr. Mayo spoke on "The Interdependence of Medicine and Dentistry." There was also held at this session a memorial hour in recognition of the prominent men who had passed away during the year. This was an innovation, and it made such an appeal that it will probably be continued at future meetings.

The setting for the 1928 meeting was excellent. The Minneapolis Auditorium provided every facility for staging an event of this kind, and the Local Arrangements Committee had made the most careful preparations. All of the section meetings, together with the exhibits, scientific and commercial, were amply housed under one roof.

A notable and encouraging feature of this meeting was the full attendance at the meetings of the House of Delegates, which indicated an active and constant interest in the welfare of the Association. It is becoming more and more important that the delegates study the needs of the organization and come to the meetings with a determination to attend strictly to their duties.

It is too early to judge of the character of the scientific material in the way of papers and clinics which were presented at this meeting, but the indications are that much of it was of a high order, and when published will record a real advance in our knowledge.

The following officers were elected for the coming year:

President Elect: R. Boyd Bogle of Nashville.

Vice Presidents: Harry W. Nelson of Minneapolis.
Harry Bear of Richmond.
J. D. Jordan of Little Rock.

Secretary: Harry B. Pinney of Chicago.

Treasurer: Roscoe H. Volland of Iowa City.

Percy R. Howe of Boston, who was made President Elect at the last meeting, automatically became President this year. Washington was selected as the place of meeting for 1929.

All in all, the 1928 meeting will record real progress. Some constructive legislation was passed, and the machinery of the organization was systematized. It remains now for every member of the Association to rally around the officers and bend every energy toward preparing for the next meeting. The organization has now grown so large and has so many important interests that it requires the combined and continued efforts of its members to conduct its affairs efficiently. To the end that its influence in the profession may result in the greatest good to the people of America, it is necessary that every member should feel himself obligated to work unselfishly for its best interests, and study with the utmost care the essentials for its greatest advancement.

PUT ON THE BRAKES

A car without brakes would be dangerous, but no more so than an individual without brakes. To let go at all times and not hold oneself in check is to court disaster; and that is precisely what some people do. It is all right to get up momentum, but there must be some means of controlling it.

The time to put on brakes is when resentment begins to surge and we want to retaliate for some injury, fancied or otherwise. The strong man is the one who can rise above resentment and hold himself in check in the face of great provocation. No matter how disturbed he may be by an injustice, or how unfairly he may feel himself treated, if he is really great he will go serenely on his way and let no man know that he is affected in the least. It requires courage and self-control to put on the brakes in the face of calumny and slanderous gossip. The natural impulse is to retaliate in kind, and "give as good as is sent"; but the big man who has a vision and sees far enough ahead will put on the brakes and smile.

Another occasion for putting on the brakes is when we are sliding down the hill of temptation and everything seems greased for the occasion. It is so easy to abandon oneself to the impulse of the hour and drift along the line of least resistance—it is so easy to go with the crowd. But the crowd does not always go in the right direction: it too frequently goes in the most convenient direction. And it is difficult to slow down and switch away from the crowd, and start to climb instead of slide.

Sometimes it seems hard to know just which is the right direction, but all one has to do is to get a mirror and look straight into it, and there will never be any doubt as to which is the way to go. There is one individual one can seldom deceive and that individual is the one that is seen in the mirror. We may fool the world, but we cannot fool ourselves.

Another time to put on the brakes is when we feel tempted to speak ill of our fellowmen. We are all so human—the best of us—and it is the most natural thing in the world for us to relay gossip when we hear it and carry it to some one else. We like the interest they show, and the sensation we are creating. We love to

hear people say: "Is *that* so? I never would have believed that." We want to be the hero who brings the message—the one on whose lips the listeners hang. We crave to be the chief actor on the stage, and we are not so very particular whether or not the lines we speak are true. "The play's the thing"—the effect on the audience. That is the time to stop short and put on the brakes. Usually, we are afterwards ashamed of the evil we have spoken of people, even though what we have said is true; and we are doubly ashamed when we find it is not true. It is poor recompense when we have injured an individual by relaying idle gossip, and contributed to the circulation of a falsehood, to say that we did not know that it was a falsehood. No one ever slept more serenely at night after speaking disparagingly of some one else, and the time to think of that is before it is spoken.

Another occasion when the brakes are needed is when we begin to worry. In the numerous exigencies of modern life, in the complexities that harass us on every hand, the tendency to worry grows more pronounced. There seem so many problems that bombard us continually and that we, with our limitations, do not seem able to meet adequately, that we fall back on the foolish prerogative of worrying. How futile it is to worry over most of the problems of the day we never seem to realize. If we would only know in time and put on the brakes; if we would reason with ourselves and stop before we have incapacitated ourselves by worry, we not only conserve our energy for fruitful effort, but we would also be happier.

Another need for the brakes is when ambition begins to overwhelm us and encompass us about. This is the time of all others when a sensible man will apply the brakes. Inordinate ambition has been the undoing of many a man, and probably will be the undoing of many more. A healthy ambition is laudable, but the kind that places a false estimate on values, and consumes a man with an overweening desire to shine before his fellows, or above his fellows, is demoralizing and dangerous. The moment a man aspires to place and honor which his talents do not warrant, that moment he begins to tread on treacherous ground. When he allows

his ambition to get the better of his judgment, he is not only foolish but he is also placing his happiness is jeopardy. Unless he puts on the brakes and stops in time, he will end in confusion and disaster.

In a general way, it is always safer to apply the brakes whenever impulse begins to assume sway. Unbridled impulse leads us into much tribulation and many sorrows, and unless we learn how to subject and control it, it is liable to keep us constantly in trouble. It is as necessary to learn how to apply the brakes as it is to know how to get up speed and maintain momentum. Speed without regulation is hazardous; energy without equilibrium is folly.

Keep your brakes in order and play safe.

AN EXAMPLE FOR OTHERS

At the Minneapolis meeting, Mrs. Sheppard W. Foster, wife of one of our Trustees, presented the following communication to the House of Delegates:

Mr. President and Members of the House of Delegates:

I bring you greetings from the Sunshine City of Florida—St. Petersburg.

This beautiful winter resort of Southern Florida, nestling on the border of the Gulf of Mexico, is noted for its sunshine and many other things (especially her green benches) and contributes in many ways to the comfort and pleasure of those of us who are fortunate enough to get away from a more rigorous climate and bask in her perpetual sunshine—perpetual, for it was just the past winter that she celebrated 365 days of sunshine.

The dentists of St. Petersburg are among the most progressive, obliging and cordial of any city, having an active local dental society. The wives of the dentists organized, about a year ago, a Woman's Auxiliary of St. Petersburg. These women are deeply interested in dentistry and felt that they wanted to do something worthwhile. They have been successful in their efforts, as they have made $100.

As an honorary member of this Auxiliary, I have been requested to present this check to the House of Delegates to apply to your Relief Fund, as these women are greatly impressed with the laudable ideal of this fund. They regret that this check could not be larger, but hope it may serve as a nucleus to encourage more and larger donations from other sources and that Dr. Ottolengui and his co-workers may realize their coveted hope for an established home for disabled members of the Association.

On behalf of the Woman's Auxiliary of St. Petersburg, Florida, I take pleasure, Mr. President, in presenting this check.

This was accepted with thanks by the House of Delegates. If this very pleasant impulse could be passed along to other groups, and they could be persuaded to do likewise, our Relief Fund would grow very rapidly and we would soon be able to guarantee that every needy, worthy member of our organization would be adequately cared for.

THE BUREAU OF CHEMISTRY

On another page, we publish the first report made by our chemist in his research on the various products that are offered to the profession and the public. We beg our readers to study these reports most carefully. The sole purpose of the Bureau of Chemistry will be to check up on the virtues or otherwise of the preparations that dentists or the people are asked to buy, with the idea not only of establishing the value of meritorious products, but also of protecting the purchaser from imposition by those whose preparations are not up to the specifications made by the manufacturers.

There is no intent to harm any one in these investigations, the sole object being merely to ascertain the truth. It is assuredly time that organized dentistry took steps to inform the members of the profession on the nature of products offered them, and that is the only intent of these investigations.

The American Dental Association is fortunate in securing the services of a competent chemist in the person of S. M. Gordon, Ph. D., who is working in the laboratory of the American Medical Association under the direction of Paul Nicolas Leech, Ph. D., director of the Chemical Laboratory. For this courtesy, our Association is under obligation to the A. M. A. for placing the facilities of their laboratory and the experience of their director at the disposal of our organization.

We ask our members to follow these reports from month to month with some care, to the end that they may become informed on a phase of our activities that has been too long neglected.

BUREAU OF CHEMISTRY

MU-SOL-DENT

REPORT ON AN ALLEGED COMBINATION DENTIFRICE, MOUTH WASH, GARGLE, NASAL DOUCHE, ETC.

A LITTLE over five years ago there was introduced to both the dental and medical professions a proprietary product under the name of "MU-SOL-DENT" manufactured by the V. B. Corporation of Pittsburgh, Pa.

According to the advertising, the product is the result of work done under a fellowship at the Mellon Institute of Industrial Research. The firm features on all advertising and cartons a "Certificate of Discovery," reading as follows:

CERTIFICATE OF DISCOVERY
THE MELLON INSTITUTE OF
INDUSTRIAL RESEARCH

Certifies that C. C. Vogt, A. M., Ph. D., an Industrial Fellow at the institute, discovered and perfected the formula of "MU-SOL-DENT," which is chemically an efficient solvent of mucin plaques.

The claims made for the product are that it is a most efficient means of dissolving mucin plaques on the teeth. Claims are also made for its use in strictly medical conditions, such as various ailments of the sinuses, in catarrh, hay fever and what not.

In the advertising of the firm, there appears the usual graphic outlines. They are entitled, "How trouble starts"; "Where trouble starts"; "How trouble is prevented."

THE MODUS OPERANDI OF MU-SOL-DENT

MU-SOL-DENT illustrations indicate that mouth trouble starts "between the teeth where *tooth paste* and *powder* fail to get in and clean," and further that, being a liquid, "MU-SOL-DENT is the only existing mucin solvent dentifrice, and is the best preventive of decay and tartar." To point out the fallacy of such to the dental profession would be like "painting the lily" or "refining fine gold."

According to the V. B. Corporation, for over twenty years independent scientists as well as dentifrice manufacturers searched "diligently for an efficient, yet harmless mucin solvent, capable of preventing tartar and removing the film on teeth in which acid forming decay germs find lodgment," without success. And the firm refers to the "inability of popular dentifrices to accomplish either of these purposes," and states that "the search was unsuccessful until, in despair, a noted dentist went to the Mellon Institute of Industrial Research, University of Pittsburgh, asking them to study the problem." They refer to the Secretary of the Treasury as a prominent member of the Mellon Institute, and they refer to the fact that "it is operated without profit in conjunction with the University of Pittsburgh."

Fig. 1.—Front of carton.

According to one of the circulars sent out by this firm on receipt of an inquiry, the product has essentially the following composition:

. . . "Ringer's Solution" has been added to a solution of 0.5 per cent of hydrated trisodium phosphate, or 0.25 per cent of the anhydrous salt, . . . The dentifrice is then saturated with the very minute quantity of calcium phosphate which will dissolve in trisodium phosphate solution, to insure absolutely that there cannot possibly be any solvent action on the enamel.

This, then, according to the manufacturer's inference, is the result of twenty years' search for a mucin solvent.

Of course, the idea involved has a little originality. It has been well known that "mucin," etc., is easily removed from the teeth when an alkaline medium is used. This can be attested to by the fact that many tooth pastes on the market today contain soap, which may be considered excellent for this purpose in that it yields an alkaline reaction and also that it possesses other cleaning properties, owing to its collodial construction. Whether or not clinical dental evidence is always in favor of soap-containing tooth pastes is still a matter of some debate. The MU-SOL-DENT "research" was the devising of a solution having the alkaline characteristics of soap, without using soap; thus was employed the well-known trisodium phosphate which hydrolyzes in solution yielding an alkaline reaction.[1]

OTHER DENTAL CLAIMS

According to the carton, MU-SOL-DENT "dissolves mucin." "MU-SOL-DENT for cleaning teeth plates and bridges more safely, quickly and efficiently than with tooth pastes and powders." In addition, "MU-SOL-DENT is a cleansing mouth wash, gargle and nasal douche when indicated. Keeps mouth and throat clean."

Further claims are:

Prevents tooth decay;
Prevents tartar;
Prevents pyorrhœa;
Cleans plates and bridges;

1. Trisodium phosphate is a common article and is an ingredient of many of the strong soap powders, wall cleaners, etc.

Heals sore and bleeding gums;
For tooth extractions;
For persons with sensitive teeth to heat or cold, sweet or fruit acids;
For removing tobacco stains on the teeth;
For eliminating stale tobacco taste in mouth and "tobacco breath;"
Mouth inflammations;
Trench mouth;
Bad breath;*
For catarrh;
Hay fever;
Colds;
Sore throat, etc.

THE "CERTIFICATE OF DISCOVERY"

What are the facts about the "certificate of discovery"?

A Dr. C. C. Vogt received a degree of doctor of philosophy in chemistry at the Ohio State University. He then took up at the Mellon Institute an investigation for the purpose of discovering a new dentifrice. When his fellowship was completed, he was issued a "certificate of discovery," which—as was the custom at that time—only concerned the chemistry of the product, and did not refer to dental claims. Since then, the Mellon Institute has profited by the experience, because it was never intended that the use of the "certificate of discovery" should be so commercialized. The Mellon Institute states, on July 31, 1928, that "(1) we no longer issue 'certificates of discovery', and have not done so since 1921, when (2) our Industrial Fellowship agreement was rewritten, the following article being placed therein: 'It is also agreed that no advertising or publicity matter having or containing any reference to the Institute, or in which the name of the Institute is mentioned, shall be made use of by the donor or any one in the donor's behalf, unless and until the same shall have first been submitted to and received the approval of the director of the Institute."

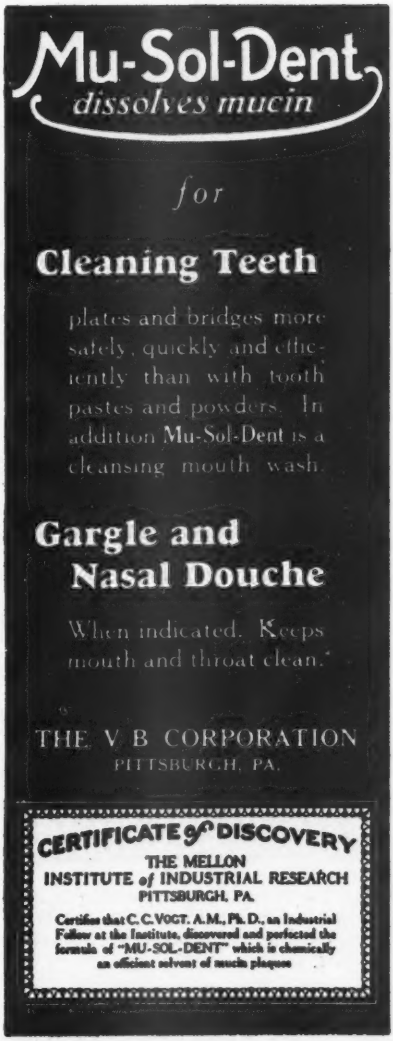
Mu-Sol-Dent
dissolves mucin
for
Cleaning Teeth
plates and bridges more safely, quickly and efficiently than with tooth pastes and powders. In addition Mu-Sol-Dent is a cleansing mouth wash.
Gargle and Nasal Douche
When indicated. Keeps mouth and throat clean.
THE V B CORPORATION
PITTSBURGH, PA.
CERTIFICATE of DISCOVERY
THE MELLON INSTITUTE of INDUSTRIAL RESEARCH
PITTSBURGH, PA.
Certifies that C. C. VOGT, A.M., Ph. D., an Industrial Fellow at the Institute, discovered and perfected the formula of "MU-SOL-DENT" which is chemically an efficient solvent of mucin plaques

Fig. 2.—Back of carton.

More recent rules and regulations issued by the Mellon Institute of Indus-

*The word "halitosis" is not used in this advertising.—Ed.

trial Research provide against the misuse of the certificates of discovery. It is quite evident that the V. B. Corporation did not use the "certificate of discovery" at all in the spirit in which it had been

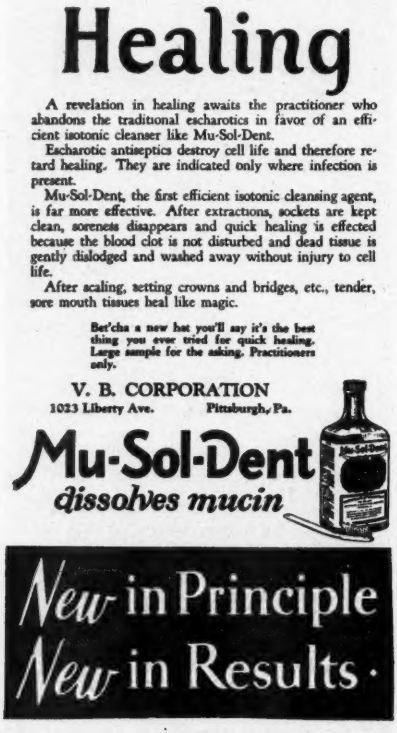
Healing
A revelation in healing awaits the practitioner who abandons the traditional escharotics in favor of an efficient isotonic cleanser like Mu-Sol-Dent.
Escharotic antiseptics destroy cell life and therefore retard healing. They are indicated only where infection is present.
Mu-Sol-Dent, the first efficient isotonic cleansing agent, is far more effective. After extractions, sockets are kept clean, soreness disappears and quick healing is effected because the blood clot is not disturbed and dead tissue is gently dislodged and washed away without injury to cell life.
After scaling, setting crowns and bridges, etc., tender, sore mouth tissues heal like magic.
Bet'cha a new hat you'll say it's the best thing you ever tried for quick healing. Large sample for the asking. Practitioners only.
V. B. CORPORATION
1023 Liberty Ave. Pittsburgh, Pa.
Mu-Sol-Dent
dissolves mucin
New in Principle
New in Results

Fig. 3.—Advertisement appearing in a recent issue of a dental magazine, and in the same issue as the reproduction shown in Figure 4.

issued by the Mellon Institute, and that the Mellon Institute is among the last ones to countenance such commercialized use, publicized in such an immodest manner. One of the Regulations Respecting Publicity, contained in the Code of Regulations, 1925, reads as follows:

All advertising or publicity matter prepared by Fellowship Donors or by their agents, wherein reference is made to the Institute or to any of its activities, is submitted to the Executive Staff for approval prior to release. Under no conditions is an illustration of the building of the Institute to appear in any advertisements in newspapers or periodicals.

Comments on the foregoing are not needed. It is encouraging to note that the Mellon Institute has evidently no sympathy with the advertising propaganda of "MU-SOL-DENT."

In order to determine the composition of the preparation and to have some idea of its action, the aid of the American Dental Association chemist was enlisted. His report is as follows:

REPORT OF THE A. D. A. CHEMIST

"Two (2) original specimens of MU-SOL-DENT (V. B. Corporation, Pittsburgh, Pa.) were purchased on the open market for the chemical investigation. Each specimen cost fifty cents. The bottle containing the liquid was enclosed in a carton, on which was given directions for the use of MU-SOL-DENT in dental and medical conditions. A "Certificate of Discovery," issued by the Mellon Institute for Industrial Research, was prominently displayed on the carton. No indication of the composition was given on the carton or on the bottle. Each bottle contained approximately 360 cubic centimeters (12 fluid ounces) of a clear amber colored liquid, possessing an aromatic odor of a mixture of essential oils. The liquid reacted strongly alkaline to phenolphthalein, indicating, as a rough measure, a high degree of alkalinity of the solution. The exact alkalinity of MU-SOL-DENT was more accurately determined by comparison against a hydrogen electrode, and found to be p_H

11.4.[2] Qualitative examination indicated the presence of chlorids, phosphate, sodium and potassium. Calcium was not found by delicate chemical tests. When tested spectroscopically, a very faint line was visible. The specific gravity was 1.033.

"Quantitative examination yielded the following results:[3]

Total solids	0.75%
Chlorids (Cl^-)	0.28%
Phosphate ($PO_4^{\equiv}$)	0.12%
Sodium (Na^+)	0.26%
Potassium (K^+)	0.009%

"From the foregoing, it would follow that each 100 c.c. of MU-SOL-DENT contained:

Total solids	0.78 gm.
Chlorids (Cl^-)	0.29 gm.
Phosphate ($PO_4^{\equiv}$)	0.124 gm.
Sodium (Na^+)	0.273 gm.
Potassium (K^+)	0.009 gm.

"From the foregoing, it may be calculated that the composition of MU-SOL-DENT may be expressed as follows:

Potassium chlorid (KCl) ..... 0.017 gm. per 100 c.c.
Sodium chlorid (NaCl) ..... 0.48 gm. per 100 c.c.
Tri-sodium phosphate (Na_3PO_4) ..... 0.21 gm. per 100 c.c.

"A solution having the essential properties of MU-SOL-DENT may therefore be prepared by dissolving in one liter (approximately one quart) of water: 1.7 gm. (26 grains) potassium chlorid; 5.0 gm. (77 grains) of sodium chlorid and 2.1 gm. (32 grains) of sodium phosphate. A solution having the foregoing composition (almost thrice the volume of the original package) as described above, can be prepared at a cost of only a few cents, exclusive of package and overhead."

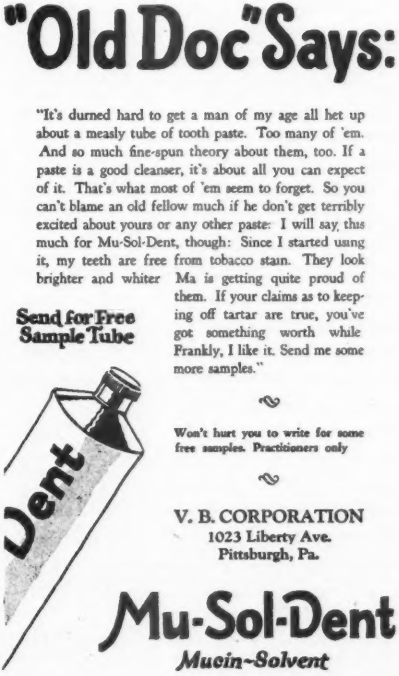
"Old Doc" Says:
"It's durned hard to get a man of my age all het up about a measly tube of tooth paste. Too many of 'em. And so much fine-spun theory about them, too. If a paste is a good cleanser, it's about all you can expect of it. That's what most of 'em seem to forget. So you can't blame an old fellow much if he don't get terribly excited about yours or any other paste: I will say, this much for Mu-Sol-Dent, though: Since I started using it, my teeth are free from tobacco stain. They look brighter and whiter Ma is getting quite proud of them. If your claims as to keeping off tartar are true, you've got something worth while Frankly, I like it. Send me some more samples."
Send for Free Sample Tube
Won't hurt you to write for some free samples. Practitioners only
V. B. CORPORATION
1023 Liberty Ave.
Pittsburgh, Pa.
Dent
Mu-Sol-Dent
Mucin-Solvent

Fig. 4.—According to an advertisement, MU-SOL-DENT can reach spaces that tooth paste and powders cannot! But evidently the public insist, nevertheless, on "pastes and powders," for now we find the V. B. Corporation advertising a paste as well as the liquid.

The statement of composition as found agrees essentially with the claims of composition as stated by the V. B. Corporation in some of its literature; this information is not conveyed on the trade package, however.

2. As will be recalled, p_H is the modern physicochemical symbol used to express the degree of acidity and alkalinity. For instance, water, which is neutral, has a value $p_H=7$. All values numerically below 7 indicate relative acidity; thus, the p_H of gastric juice—that is, 0.2 per cent hydrochloric acid—is 1.7. p_H 11.4 indicates a relatively alkaline solution. The p_H of the normal saliva is approximately 6.8 to 7, while that of blood is 7.4-7.6.

3. The details of analysis will be reported elsewhere.

From the foregoing report, it can be seen, therefore, that MU-SOL-DENT is essentially a simple alkaline solution, and, like all such dentifrices, contains certain flavoring and agents. There is nothing in the preparation that deserves the halo of discovery with which the V. B. Corporation tries to crown the product. The chemist's report is of interest in another connection. The chemist was unable to find any perceptible amounts of calcium, even by a most delicate test. It is rather strange, then, to be advised that the "very minute quantity of calcium phosphate" dissolved in trisodium phosphate solution insures "absolutely that there cannot possibly be any solvent action on the enamel."

Practicing dentists know well that they can obtain excellent results from the use of soap and water plus a little rubbing of the teeth. Tests made with this method indicate that one can get essentially the same smooth feeling of the mouth and teeth by using a solution of soap as by using a solution of MU-SOL-DENT.

As far as the dental claims are concerned, one needs only to point out that if they were as true as the advertising would make one believe, there would be little need for the services of the dental profession.

Furthermore, the dental profession is not at all agreed that mucin plaques should be removed *daily* by means of an energetic alkaline medium.

Until the MU-SOL-DENT Company presents rigidly *controlled* scientific dental evidence of a satisfactory character to uphold its claims, dentists may look askance not only on the product, but also on the propaganda. The profession would do well to discourage the exploitation of this substance to the public through its medium.

BUREAU OF DENTAL HEALTH EDUCATION

NEW YORK SURVEYS ITS DENTAL CLINICS

By CLARE TERWILLIGER, A.B., New York City

A PUBLIC HEALTH ORGANIZATION CONSIDERS DENTISTRY

WITH dentistry assuming an active and important place in the field of preventive medicine, a public health organization must ask two questions: Does our city afford adequate dental services to meet the needs of our population? How does our progress in the development of dental facilities compare with that of other cities? To discover the answers to these questions, in 1927, the New York Tuberculosis and Health Association repeated a survey of community dental service which was first made four years ago by a temporary research committee of the United Hospital Fund, the Committee on Dispensary Development. The present paper, an abridgement of the survey, "Dental Clinic Services in the City of New York," by the New York Tuberculosis and Health Association in cooperation with the Welfare Council Health Inventory, September, 1928, has been prepared for publication in THE JOURNAL in order that the information gathered in a study of New York's dental health problems may be available to a wider public, and may be useful to other communities planning to meet their need for dental care through organization of clinic services. The unabridged survey, a 32-page book, is necessarily limited to a smaller circulation.

THE SITUATION IN 1923

The 1923 survey revealed that dental clinic service was an important, unrecognized, unrelated phase of organized community health; and it recommended that some local health organization include in its program a department for community dental service. Such a department was organized by the New York Tuberculosis and Health Association, and has now been in operation four years. It provides for the administration of an experiment in self-supporting dental service,[1] general promotion of dental clinic facilities, specific dental health education and research studies. The present survey is the latest study made in this department.

WHY A SURVEY?

"Dental Clinic Services in the City of New York" brings up to date the available information on dental service in clinics and institutions, outlines the progress made since 1923, when the field was first called to the attention of health workers by the Committee on Dispensary Development in its survey, and indicates the direction in which further development must proceed to meet New York's need

1. The Allied Dental Clinics.

in dental health. The survey shows in perspective the methods and results of the past, and makes it possible to compare recent gains with similar progress in other cities, thus providing a sound foundation for future planning.

PROCEDURE

A trained investigator, not a dentist, personally visited all of the clinics in Greater New York known to offer dental service. One hundred and fifty-two clinics were found, an increase of forty-eight since 1923. Fifteen of the 1923 clinics having subsequently closed, the present survey includes sixty-three new clinics and eighty-nine clinics surveyed for the second time.

DISTRIBUTION IN ORGANIZATIONS

The distribution of clinics according to organizations in which they are operated is given in the accompanying table.

DISTRIBUTION OF CLINICS*

Hospital clinics	60
Unattached clinics	13
College clinics	2
Health agency clinics	8
Family welfare agency clinics	9
Settlement clinics	8
Church clinics	6
School clinics	39
Institutional home clinics	6
United Workers' Cooperative Association Clinic	1
Total	152

*Seventeen serving inpatients and forty-three serving outpatients.

CLINIC SERVICES VARY WIDELY

The survey discovered fifteen different combinations of services offered in the clinics, ranging from extraction only or prophylaxis only, to complete provision for dental care, which includes cleaning, filling, extraction, surgery, restorative work, pyorrhea treatment and orthodontia (correction of irregularity in the position of the teeth). This complete program is found in seven institutions: five hospitals and the two dental colleges. The services most frequently found are cleaning, filling and extraction, which are offered in seventy-five clinics, constituting almost half the total number of clinics. Among these seventy-five clinics, thirty-five are school clinics, the largest number in which like institutions are doing like work. Of the remaining seventy-seven clinics, forty-eight offer services more complete and twenty-nine offer services less complete.

PREVENTION EMPHASIZED

The emphasis today in dental work as in the whole field of health work is on prevention. Curative and reparative work are necessary for the adult who has a diseased mouth with decayed teeth, but the health worker in dental hygiene looks forward to the day when preventive dentistry will lessen the need for mechanical devices and artificial teeth to replace the natural teeth. A preventive program will institute proper nutrition for the expectant mother and for the new-born child, and will follow up such early nutritional precautions with dental care from the age of 2.

PHYSICIAN AND DENTIST COOPERATE

Scientists recognize the far-reaching effect which disease in the mouth has on the general health. Many systematic diseases have been traced to oral infection, and cure has been effected after the correction of the mouth condition. The physician and the dentist are finding that cooperation is necessary for constructive health work.

AN INSTANCE OF DENTAL NEGLECT

Although each year records progress in community dental service, abundant evidence points to the great need still to

be met. For example, in one district where 580 grammar school boys whose previous dental care had been almost negligible were examined recently, it was found that the group averaged, for each child, eight decayed teeth requiring filling and three teeth decayed beyond repair. When one realizes that these children barely have all their twenty-eight permanent teeth, exclusive of the third molars, and average eleven teeth either needing repair or beyond saving, the urgent necessity for a more strenuous effort toward community mouth hygiene becomes apparent. At the present time, delay of preventive work, owing to the pressure of curative work, establishes a vicious circle, as it increases the need for curative work and again postpones prevention with its really constructive possibilities.

SERVICES FOR THE WHOLE POPULATION

A community dental program presupposes that those who can afford the services of a private dentist are having regular dental care. This is not true, since health education has not yet become so extensive as to make the man of moderate means demand dental hygiene, and consequently the private dentist is usually called on only after disease of the mouth and resultant pain have progressed so far that the individual must have a tooth filled or extracted for relief. Regular preventive care of the mouth while it is healthy remains an ideal toward which the dental profession looks with hope, as it would result in a saving of much pain and often serious illness involving more than the mouth.

The clinic serves in almost every case a limited underprivileged group, and where preventive care is practiced, furnishes its clients with the best contribution toward health that dentistry can make. Except for the two clinics connected with the dental colleges, the patients of each clinic are subject to the dispensary law of the state, which makes it a punishable offense to obtain dispensary service under false pretenses regarding financial ability to pay private practice rates. Most of the clinics, in accordance with this law, set a wage limit above which an applicant is not eligible for clinic care. Fully half of the established clinics restrict their clientele to residents of a geographic area, while many serve only members of an organization, as clients of a social agency, inmates of an institution, students of a school or members of a settlement club or church.

Seventeen of the sixty hospitals studied serve inpatients only. Many of the remaining forty-three serve only patients referred for care from another clinic of the outpatient department. Sixty-five clinics admit children only and specialize in preventive work. Forty-three clinics, or nearly a third of the total number, serve all members of the community eligible for dispensary care, with no further restriction.

DENTAL WORK IN THE CLINICS

Dental clinics in hospitals have increased from thirty-nine in 1923 to sixty at the present writing. This growth can be directly attributed to the realization in medical care as to the distinct contribution which oral hygiene brings to the cure of disease, and the value of dental treatment to complete other therapeutic treatment of patients. While some of the hospitals call the dentist only in emergency cases to relieve pain, in others the hospital authorities recognize the importance of oral hygiene in every case entered and have instituted the routine mouth examination of all patients as part of their procedure, to be followed by prophylactic and curative work as indicated. More than half of the hospitals

now maintain dental departments side by side with the medical specialties. Five of the forty-three hospitals with outpatient departments offer complete dental care, and twelve offer every service but pyorrhea treatment and orthodontia.

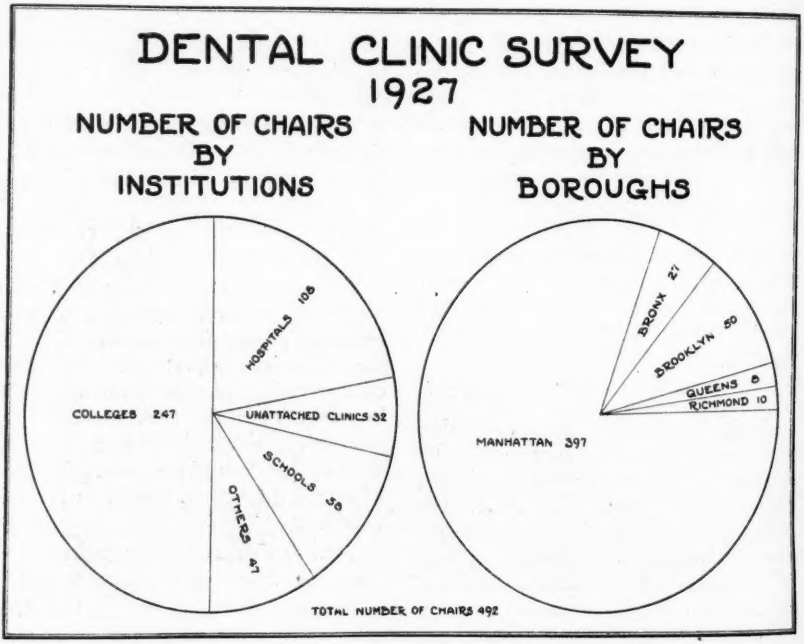

Fig. 1.—Distribution of 492 chairs of 516 for which service could be estimated.

Eleven hospitals now employ twenty interns, graduate dentists who give full time to the hospital and its clinic, making routine mouth examinations, following up the examination with corrective care, and working with physicians so that clean mouth conditions can facilitate the cure of the illness which brings the patient to the hospital.

The unattached clinics are comparable to the outpatient departments of hospitals except that they offer no bed care. Their services vary from extraction only to complete dentistry. The clinic which does not furnish complete care should not let a patient leave without referring him to another clinic where his work can be completed. There is a real social need for complete care, since isolated pieces of dentistry cannot benefit the patient as does a comprehensive dental health service.

Both dental colleges offer the community all types of dental service at the cost price of supplies. The work is done by students under supervision, and the clientele is unlimited. The services of the Columbia students in oral hygiene are available during their second semester, when practical work is required. It is necessary that some interested organization pay the salaries of supervisors.

The Association for Improving the Condition of the Poor and the New York Tuberculosis and Health Association pay supervisors and thus make prophylactic cleanings possible for many hundred school children each year.

ganizations. Beginning in the fall of 1928, the department of health is changing its policy in regard to school clinics. In all schools provided with dental equipment (there are now 116), a diagnostic service will be conducted. The nineteen

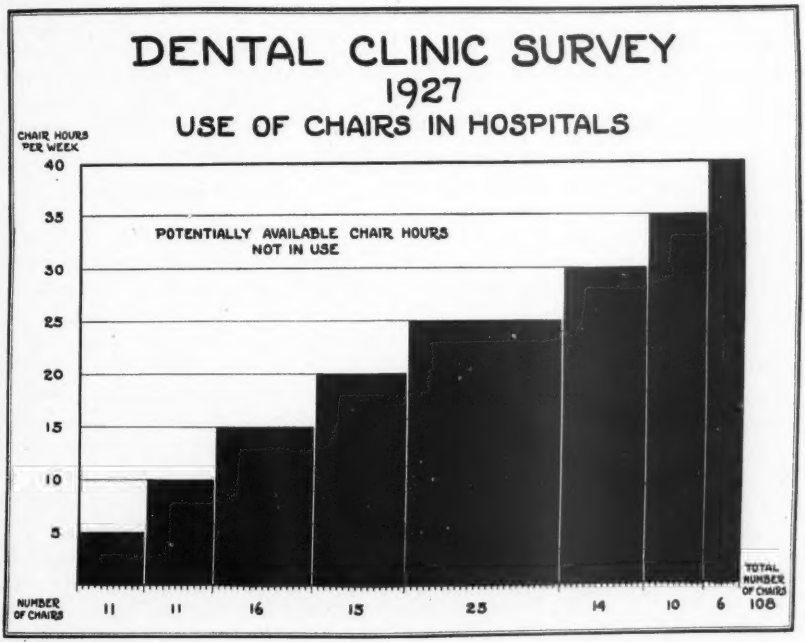

Fig. 2.—Actual chair hours in hospitals as compared to their potential chair hours on an average full-time program.

In clinics maintained by health agencies, family welfare agencies, settlements and churches, children's and preventive dentistry receive major emphasis. Since many private dentists object to doing work for children, the social agency child is in some cases receiving more thorough care than the child with supposedly better advantages.

There are now thirty-nine school clinics, nineteen of which are supported by the department of health, the remaining twenty being conducted by private or-

clinics formerly operating will be opened Saturdays for curative and reparative work. All children examined and found to have dental defects will be urged to plan for their correction either through clinic care or that of a private dentist. Reexaminations every six months will serve as a checkup on the correction of defects and the improvement of mouth conditions. A uniform procedure has been adopted by the department of health curative clinics whereby the child with dental defects will receive, in the order

mentioned, prophylactic cleaning, removal of unsavable teeth, filling of pits and fissures before they become carious and filling of decayed permanent teeth. This new policy, it is hoped, will bring to an increasing number of children and their parents the realization of the need for dental care. Educational pressure will doubtless increase the number of patients visiting private dentists and dental clinics.

The institutional homes, whose clinics serve only inmates, are not significant from a community dental health point of view, because their service is not open to any appreciable number of the population. However, the movement to establish dental service in institutional homes, though still in its infancy, indicates the trend toward dental health consciousness which will result in bettered dental health and general welfare.

The United Workers' Cooperative Association, an organization for mutual benefit of a thousand families living in the Bronx, conducts a clinic which offers its members complete dental care.

SURVEY SHOWS ACTUAL AND POTENTIAL SERVICE

There are 516 dental chairs in use among the 152 clinics. About a hundred additional chairs, most of them installed in public schools, are not now in use. (It should be noted that chairs in schools will be used for diagnostic service in the fall of 1928.) Figure 1 indicates the distribution of the 492 chairs out of the 516 for which service could be estimated. They are shown according to institution and according to borough.

The measure of service can be represented most clearly by the number of hours each week that each chair is in use for the treatment of patients by a dentist or a hygienist. Full time service lies between thirty-three and forty-two hours' use of each chair. Figures 2-3 show the actual chair hours in hospital and non-hospital clinics as compared with their potential chair hours were they operating an average full-time program. College clinics have been omitted from these charts, because it is their aim to provide their students with a specific amount of practice in each branch of dental service, and their schedule is planned for this teaching work rather than to meet community needs in dental care.

SERVICE INADEQUATE

Despite the large number of clinics in Greater New York, health workers seeking clinic facilities for their clients and clinic personnel both report that the supply of service is entirely inadequate to meet the present community needs. The policy of the larger hospitals to give routine mouth examinations and to follow up such examinations with dental care to remove focal infections in the mouth has increased the demand for clinic services and general dental prophylaxis.

This constantly growing demand for dental services must be met. There are two ways to extend the service to meet the demand: Establish new clinics and use to the maximum the equipment and clinics now existing. The average use of each dental unit is sixteen hours a week, or less than half time. The logical first step in developing the service is to operate installed equipment to a fuller extent before investing in new equipment. Hospitals, unattached clinics, health agencies, family welfare agencies, settlements and schools can increase their service 100 per cent, while church clinics can triple their present hours of service. On the other hand, the total inadequacy of clinic services in the boroughs other than Manhattan, as shown in Figure 1, demands

the establishment of new clinics to serve their populations.

HEALTH EDUCATION AND ORAL HYGIENE

A consideration of the place of dental clinics in a community health program cannot be closed without mention of health education in relation to oral hygiene. Many clinics which offer prophylaxis also provide instruction in oral hygiene in the care of the teeth and the effect of diet on mouth health. But health education in oral hygiene is still a pioneer field. Figures compiled on the mouth conditions of school children show that from 75 to 95 per cent have decayed teeth. Preventive dentistry must start with the preschool child, since the majority of children enter school with decay already present and in many cases at an advanced stage. To produce measurable results, health education in oral hygiene must begin with the expectant mother, be carried through the preschool period and the child's formal school education, and continue by means of general publicity throughout the postschool age.

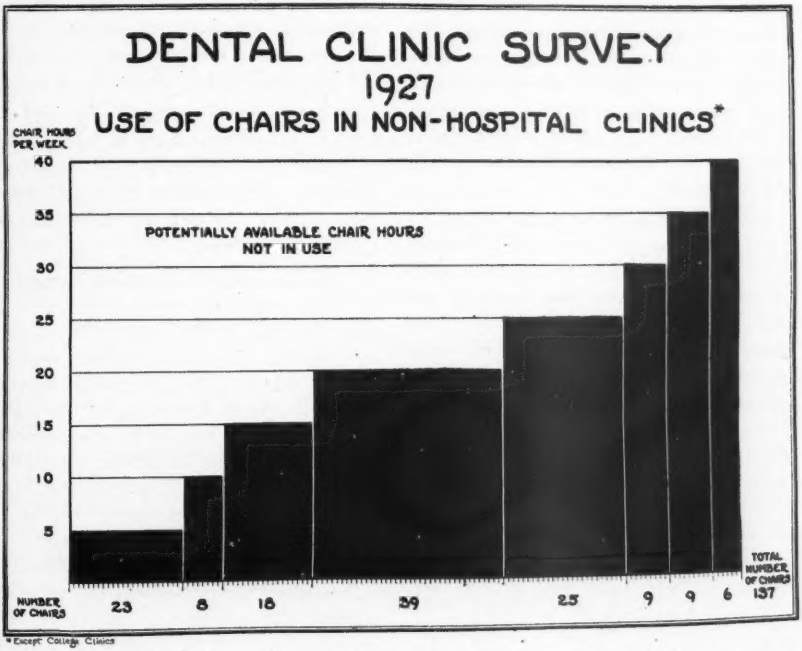

Fig. 3.—Actual chair hours in non-hospital clinics as compared with their potential chair hours on an average full-time program.

Authorities agree that the 2-year-old child is not too young for his first visit to the dentist. The individual who would grow and keep healthy teeth and maintain a clean mouth condition should be under the regular care of a competent dentist, visiting him for examination and prophylactic cleaning at least twice a year.

ADMINISTRATION OF THE CLINIC

The clinic serves the patient best where a separation is made between technical and administrative operation. For the technical operator—dentist or hygienist—the patient and his needs should be the focus of attention. Costs, records, equipment and other administrative detail should be attended to by a person or persons not concerned with the actual work of treating patients in the chair. Good technical work is oftenest found in clinics where efficient administration is also evidenced.

Professional supervision, as defined by the Committee on Dispensary Development, when it found, during the making of the former survey, that the term was much misunderstood, is as follows: "By supervision the Committee does not mean occasional fault finding inspection or the establishment of a board supervisory in name only. Professional supervision consists in assuming responsibility for the quality of the work turned out and in availability for consultation; but, more than that, it means a constructive interest in the work which develops a stimulating morale. Work supervised in this way not only maintains its permanency but also builds for future development." More than half of the clinics now have such supervision.

CLINIC PERSONNEL

At least one licensed dentist is connected with each clinic. Professional personnel other than the operating dentists may include the supervisor and dental hygienists.

The majority of dental clinics now offer some payment to part of the staff. The amount ranges from 75 cents an hour to $7.00 an hour, the most usual rate being $2.50. Supervisors and hospital staff members who find compensation in the experience in special phases of dentistry less common in private practice are often willing to serve without pay. Dental interns who spend a year as residents in hospitals are provided with board and lodging, and, in some instances, with a monthly allowance. The policy of routine mouth examinations with followup care to remove focal infection has led to the increased use of interns.

Fifty of the clinics now employ hygienists as against thirty-two in 1923. The hygienist, in most instances, is obliged to divide her time between the strictly professional work of cleaning teeth and administrative duties.

The administrative personnel, whether the staff consist of one or more persons, must perform all the duties of the clinic not strictly professional, such as the technical work done by the dentist or the hygienist and the recording of the work on the patient's chart. Each clinic should have a permanent attendant responsible for sterilization and cleanliness, and for assistance such as the doctors may need. Nontechnical duties also include all clerical work and detail connected with record keeping, fee collecting, appointment making and meeting of patients. The distribution of these duties ranges from the small clinic where one hygienist performs all the tasks enumerated in addition to the technical work for which she is trained, to the large clinic with registrars, file clerks and doctors' assistants.

THE IMPORTANCE OF RECORD KEEPING

Apart from measuring service to the individual patients and to the clientele as a whole, records should furnish a means for comparing clinics and estimating the community value of each clinic in terms of actual service performed as related to potential service. Because of the variety of records and methods found,

their research value cannot be made use of. It would be a distinct advantage to have a form devised by a statistician for use in clinic recording, to insure that it would record objectives and statistically useful comparable data.

Two types of record must be kept in every clinic: the individual case record and the daily tally sheet. If the patient's record is to be a contributing factor in his care, it should include social and medical history bearing on clinic treatment, and entry of each operation performed, the fee charged and any other pertinent information. Operations performed should be entered by the operator; all other entries can be made by the record clerk.

It was found that daily tally sheets as well as individual case records varied from clinic to clinic as to form, content and terminology, which made the data incomparable. Only one third of the clinics keep daily tallies, although almost every clinic keeps some sort of record for each patient. The daily tally sheet can be easily made from the patients' cards. It should include the number of patients admitted, the number of visits made, the number of various services offered each patient and the dentist and hygienist chair hours.

An unusual number of one visit cases should be a danger signal to the dental clinic. It indicates that the service is not adequate, since complete dental care necessitates more than one visit for each case. One clinic having a first-grade rating for plant and administration from the state board of charities was carefully studied over a period of two years. Its average number of visits for each patient was seven, and there is every reason to believe that the number represents a fair average, if not a minimum number, of visits for complete dental care.

FEES

The usual admission fee to the dental clinic is 25 cents. City and federal institutions, hospitals serving bed-patients only, schools and institutional homes could not be considered in a study of fees since they are restrained either by law as in the case of the public institutions, or by the nature of their clientele, as in the case of institutional homes, from charging any fees. In the seventy-four clinics not so restricted, admission ranges from no charge in the case of twenty-three clinics to $1.50 for admission fee for one clinic. Twenty-eight clinics charge 25 cents. In many pay clinics, the registration fee is subtracted from the patient's final bill; some clinics make no service charge over the admission fee. With the charge of greatest frequency resting at 25 cents, the general trend is toward larger fees.

EXPENSES

In very few clinics are expenses for operating the clinic computed. Cornell Clinic and the Allied Dental Clinics report themselves partially self-supporting. Few clinics approach self-support, but rely on the funds of sponsoring or affiliated organizations. The Allied Dental Clinics, operated as a demonstration by the New York Tuberculosis and Health Association, have kept a careful cost accounting record. Exclusive of all plant costs and original equipment, and inclusive of a rate of pay considerably below average for professional service, the Allied Dental Clinics find that the cost of dental care, although varying from time to time, falls between $3.00 and $3.50 an hour.

NEED FOR CLEARLY DEFINED POLICY

Administration is greatly facilitated by a clearly defined policy for the clinic. The former survey of clinic services re-

vealed a lack of planning in fitting the dental department into the general organization, in defining the types of service and in determining the choice of patients to serve. Although it is impossible now to measure the results of present planning, there is evidence of more supervision, both technical and administrative, in the clinics; and, in hospitals, a greater use of the dental service by other departments, and use of central record systems to enable the doctors to study the patient's mouth condition in relation to his general health.

PRIORITY SCHEDULE FOR PATIENTS

As to precedence of patients, the Associated Outpatient Clinics Committee recently made a formal recommendation that hospitals maintaining dental clinics observe the following schedule of priority for the selection of patients:

1. Inpatients—to receive routine complete diagnostic service with roentgen ray, surgery and operative work sufficient to eliminate focal infection in the mouth.
2. Outpatients referred to the dental clinic by other clinics of the outpatient department—to receive such dental care as their medical condition requires.
3. Outpatients who apply for dental work only—to receive necessary care.

It is understood always that emergency dental care for the relief of pain shall be furnished any applicant.

This seems to be a formative period in the organization of community clinics, but the trend is toward clearer cut administration, better quality professional service and, consequently, greater service to the community.

INTERDEPENDENCE OF MEDICINE AND DENTISTRY

The interdependence of medicine and dentistry has been recognized by health agencies in their programs directed against tuberculosis and heart disease, the care of expectant mothers and the campaign for maternal and infant health. Cooperation among physicians, dentists and health workers has increased as constructive health has become the ideal.

CLINIC SITUATION IN 1923 AND 1927 COMPARED

As increase in the number of clinics from 104 in 1923 to 152 in 1927 represents a proportionate increase in each class of institution considered, the relation of the number of hospitals to unattached clinics, and the other classifications remains approximately the same. The usual tendency for service to concentrate in Manhattan is again apparent. (Fig. 1.)

Limitation of clientele was found to have increased in 1927, so that three-fourths of the institutions instead of one-half now recognize some sort of restriction. This may be explained by the increased feeling of responsibility for a complete service to a definite group, an attitude noted especially in the hospitals.

The same lack of uniformity in types of service offered at each clinic was found. In both surveys, the service combination most often found was cleaning, filling and extraction, about 49 per cent of the clinics offering these services.

Both surveys show that the clinics have been open for use only half the potential time. This has not been because there was no greater demand for dental services; but, because of expense or convenience, it has not been found practicable to extend the use of the equipment to its maximum. A full use of equipment

would aid substantially in meeting dental clinic needs.

Professional supervision of clinic work increased 11 per cent between 1923 and 1927, 56 per cent of the clinics now being under supervision.

The increase in the routine mouth examination of ward patients or special groups in hospitals is also notable. Thirteen per cent of the hospitals reported routine mouth examinations in 1923. In 1927, the percentage increased to 39. Sixty-one per cent of the hospitals now recognize dentistry as a department equal to other specialized departments in the organization, an increase of 12 per cent over such recognition in 1923.

CONCLUSIONS AND RECOMMENDATIONS

The major conclusions and recommendations that emerge from this survey are unmistakably clear. Wise leadership, constant stimulation, clear objectives and an active recognition of community responsibility are needed. Five definite objectives rise out of the survey:

1. Dental clinics should be made available to the needy inhabitants of the Bronx, Queens, Richmond and Brooklyn, where the service is even less adequate than in Manhattan.
2. Existing dental clinic equipment should be used as fully as possible by extending the hours of use for each chair before additional chairs are installed.
3. Dental clinics generally need a clearer grasp of the exact ends to be achieved and the means to be used.
4. Hospitals that have not yet recognized diagnosis and treatment of mouth conditions as a specialty of medicine should be encouraged to establish dental service under the recommended conditions.
5. A comprehensive city-wide plan for the coordinated development of adequate dental clinic facilities, especially for children from 2 to 16, should be instituted when adequate funds are available to insure competent leadership and the necessary facilities.

THE SELLS-HEALTH-O CIRCUS

The circus has come to town,
The elephant and the clown,
The kangaroo from Timbuctoo,
And bears of cinnamon brown.

THE lure of the circus is traditional. The glare and flare of gaudy canvas, the odor of sawdust, the noise, confusion and paint, the spectacle of acrobats and clowns, bareback riders and trained animals never grows old. Since time immemorial, the word circus has exerted a universal appeal. Writers and artists, stage and moving picture directors have used the theme with success.

The Mouth Hygiene Section, Child Hygiene Division, Illinois State Department of Public Health, has developed a circus, woven a dental health message into its fabric, painted it with the gaudy colors of the tent flaps, endowed it with the odor of the sawdust ring, enlivened it with the voice of the barker's ballahoo, softened it with the voices of children, subdued it with the songs of childhood, and sent it forth to the various cities and towns of the state to instruct entertainingly its children and incidentally its adults as to how to develop and maintain good teeth.

L. W. Morrey, Superintendent of Mouth Hygiene, Illinois State Department of Public Health, and Mrs. Morrey, authors of "The Bad Baby Molar," and "Stepping Stones to Happiness," have written and developed this latest dental educational feature, which they have appropriately named "The Sells-Health-O Circus," the greatest show on earth.

The outside properties or material, consisting of an outside entrance resembling as nearly as possible the main entrance to the "Big Top," and the inside properties, consisting of ten miniature stages, are made of knockdown material which can be shipped from place to place in four crates. The entire shipping weight is 750 pounds. The project was designed to be shown in school auditoriums, club rooms or exhibition halls. As the audience approaches the box office, which is situated just outside the main door to the auditorium, they see a large archway 7 feet high. This arch is made of seven sections or blocks. Six of the sections are lettered "Diet," "Rest," "Exercise," "Sunlight," "Cleanliness" and "Dental Attention"—the six rules which the Illinois State Department of Public Health is teaching its children for building good teeth and good health. The seventh block or keystone of the arch is made in the shape of the first permanent molar. The arch itself stands about 4 feet away from the doorway. An orange colored canvas canopy is stretched from the arch to the main door. The frame work for the arch and canopy is made of angle iron, and the seven sections including the tooth are made of compoboard stippled to resemble stone and bolted in sections to the framework. The tooth is illuminated with twinkling lights.

At the side of the archway is a life-size mechanical clown which nods its

head from side to side and moves its hands and feet up and down. From the feet and hands are suspended large balloons, which bob up and down, to the delight of the children. To bring out further the circus effect, large canvas posters proclaiming the world's most beautiful lady, and Hercules, the strong man, flaunt themselves in gaudy fashion on either side of the entrance. Other signs featuring the "Greatest Show on Earth" and the "Famous Grinder Family, 32 in Number," are to be seen.

After the audience gazes at this spectacle for a while, they pass through the entrance way into the "Main Top." Either on the stage or placed around the room at regular intervals are ten miniature stages 3 feet high by 2½ feet wide. These stages are painted and trimmed in various colors, but each minutely represents the proscenium of the main street theater. Each stage is placed upon a table 3 feet high. Behind each stage stands a 12-14 year old girl with her head thrust through the back drop. From the neck of each child is suspended a doll. Each of these dolls represents a different character—milk, whole wheat bread, vegetables, fruit, sunlight, exercise, rest, cleanliness, the dentist and lastly, a tooth. As the audience files into

Fig. 1.—Main entrance to Sells-Health-O Circus.

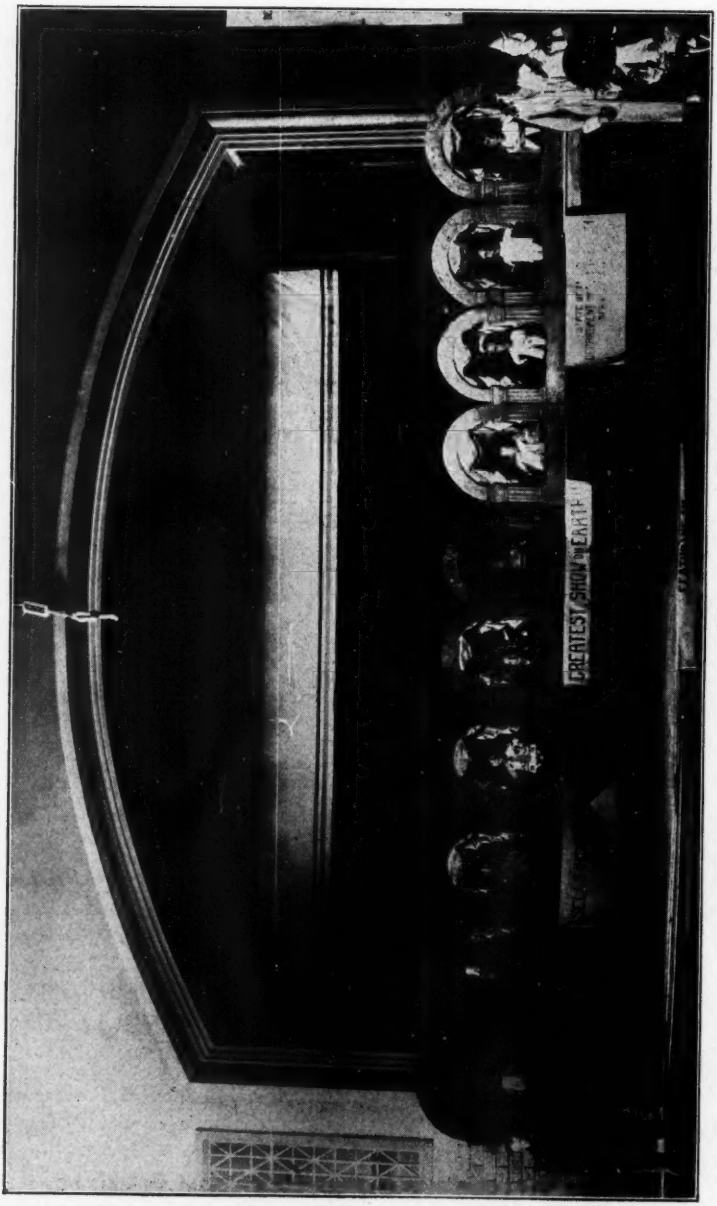

Fig. 2.—"Allow us to call your attention to the long line of stages that adorn this room. Ten artists, each and every one depicting one of the major actors in the play of life."

the room, all they can see are the ten artistic miniature stages in each of which is an animated doll representing one of the actors in this play of health.

The high school band opens the show. Next the ringmaster introduces Mother Nature, and Mother Nature in turn introduces each of the characters. The characters in turn do their little song and dance, each describing how they can help build and maintain good teeth. The performance closes with a strong, stirring march by the band.

Complete copies of the words for each character in the circus can be obtained from the Mouth Hygiene Section of the Illinois State Department of Public Health, Springfield, Ill.

The outside properties, as heretofore described, made up of an outside entrance, and inside properties consisting of ten miniature stages and the bodies of the dolls which are used by each child actor on his individual stage, are available only within the state of Illinois. However, this does not prevent persons outside the state from carrying out the idea and having a similar circus of their own.

Here is a wonderful project in health for a school or group of schools to work on. A girls' class in sewing could make the dolls and stage hangings; a boys' manual training class could make the "main entrance" and stages; an art class could do the painting or coloring of all the properties. Lightweight materials could be used for the main entrance and stages, and the problem of shipping and breakage would not then have to be considered.

The Sells-Health-O Circus was developed to entertain and instruct the young, but it has been equally successful in holding the attention of the adult for the full forty minutes of its performance.

SUNLIGHT, ULTRAVIOLET LAMPS AND HEALTH

The U. S. Public Health Service says: "Almost every new discovery in the scientific or medical field becomes a fad and is often carried to extremes. Scientific workers have recently shown the necessity and importance of sunlight for the maintenance of the health of children and adults. The beneficial action of sunlight in the cure of certain diseases of children and adults has also been pointed out.

"One of the things which have been advocated a great deal recently, and which have proved of much benefit for children, is the sun bath. These sun baths are healthful not only because the child receives the beneficial direct rays of the sun, but also because of the fresh air which it is thus bound to receive regularly.

"Scientists have shown that direct sunlight not only prevents rickets, but if given regularly, will ward off many of the illnesses which are common in children. Tuberculosis would suffer a sharp decline among children if all mothers gave this simple treatment to their children.

"In giving sun baths to the children, it is well to keep the following facts in mind:

"1. Exposure to the sun must be gradual or else the child may receive a sunburn.

"2. At first, give the baby direct sunlight for about ten minutes, increasing this bath from three to five minutes daily until he receives exposure one hour in the morning and one hour in the afternoon. This will vary, depending on how the skin reacts to the exposure.

"3. Be sure that the exposure is carried on in some spot sheltered from the wind.

"4. Sun baths may be given on enclosed porches or in the house, provided the sun can shine on the child unobstructed by glass.

"5. Certain special kinds of glass have been devised which permit the passage of the majority of the beneficial rays of the sun. Such glass may be used if desired.

"The foregoing directions also apply to adults, who should observe similar precautions and avoid prolonged or sudden exposure to sunlight, as injurious or even dangerous sunburn may result if the sunburn is extensive.

"In case sunburn does occur, the following has been found to be useful:

"Make a lotion as follows: Take one-half a pint of hot water and stir into it a level tablespoonful of boric-acid powder; then add 20 drops of carbolic acid, and shake well. The solution should be dabbed on the inflamed skin with a small piece of cotton or sprayed on with an atomizer. It should not be rubbed into the skin. It can be applied every half hour, if necessary. If no medicine is available, cold compresses will give relief to badly burned areas."

On the other hand, over-enthusiasm for sun baths, or for their substitute, the ultraviolet lamp, may have serious consequences.

The American Medical Association offers a timely warning:

"The tendency of therapeutic methods to be adopted and discarded in great waves of popularity and forgetfulness has never been so completely manifested as in the current attention given to the use of physical therapeutic methods, particularly the ultraviolet ray. Not only do barber shops swindle prospective victims of baldness with incandescent lamps colored purple, not only do electrical corporations sell, as ultraviolet ray devices, contraptions delivering hardly any ultraviolet radiation at all, but some manufacturers of apparatus actually delivering ultraviolet rays of potency endeavor to place these devices wherever a sale can possibly be made.

"Regardless of the fact that practically every method in medicine that may do good can also do harm, these machines are being sold to bath institutes, swimming pools, massage parlors, beauty shops, clubs, barber shops and innumerable other businesses in which medical supervision is certainly not probable, indeed, hardly possible. The sales are made notwithstanding the fact that scientific literature has already revealed that the rays may in some instances depigmentize or bleach the skin, that they possess dangerous effects for the eyes, that some people who do not tan easily are exceedingly poor subjects, that persons with a tendency to pellagra develop serious skin symptoms, that persons with low blood pressure react sometimes with serious symptoms, that persons with early tuberculous conditions may be greatly harmed, that menstruation constitutes a contra-indication to the use of ultraviolet rays and that there are innumerable records of severe skin eruptions following over-exposure to ultraviolet rays in persons who are unduly sensitive.

"Moreover, the rays are being advised as useful in a vast number of conditions for which the scientific evidence is extremely slim. It recognizes in many a limited application as demonstrated by scientific evidence. It must continue to deprecate the uncontrolled use of such agencies in the hands of those without scientific knowledge and in such a manner as may result in serious harm."

In other words, ask your doctor first.—*Bull. New Mexico Bur. Pub. Health,* Aug. 21, 1928.

CURRENT LITERATURE

EXTRACTS AND ABSTRACTS

Ethylene-Oxygen in Dental Surgery: The scope and utility of ethylene-oxygen anesthesia in dental, oral and minor surgery is discussed by George F. Seeman (*Cur. Res. Anes. & Anal.,* July-August, 1928). The use of nitrous oxid in conjunction with ethylene is recommended as best for office work. It is especially recommended as solving the problem of the stimulated or fighting type of patient. Marked analgesia is present in from twenty to seventy seconds, depending on the type of patient. Muscular relaxation and a general sense of quiet and well-being are noted and loss of consciousness quickly intervenes. A smooth, regular respiration of good volume and depth means good anesthesia. There is not the labored respiration frequently observed under nitrous oxid-oxygen. A slowing, shallow respiration means too deep an anesthesia, which is corrected by reducing the flow of ethylene or temporarily increasing the oxygen. Blood pressure tests have been too infrequent to warrant conclusions. In the cases observed, slight depression attended rather deep anesthesia but no change was noted in lighter anesthesia. The skin is pinkish during and for some time after the anesthesia. Slight exhilaration is sometimes evidenced. With the favorable type of patient, the skin is dry

and warm. Sweating is sometimes noted in the muscular or anemic types. Recovery is very prompt, the mind clearing first, and muscular control returning immediately after. The disadvantages are listed as: unpleasant odor; slightly increased oozing of blood from sockets of extracted teeth; inflammability, and freezing. The advantages are: 1. Ease of induction and quick recovery. 2. Wide margin of safety because of the high percentage of oxygen possible in the anesthetic mixture. 3. Muscular reaction without cyanosis. 4. Lack of respiratory irritation. 5. Absence of excitement during induction. 6. Absence of excessive sweating with its attendant dangers. 7. Ease of maintenance of anesthesia. 8. Absence of postanesthetic excitement. 9. Low percentage of nausea. 10. Absence of postoperative disturbances, such as loss of appetite, headache and sleeplessness.

The Teeth and Focal Infection: There appears to be some measure of doubt in the minds of many members of the profession as to whether nonvital noninfected teeth should be left in the mouth. Some dentists consider the determining factor to be whether there is a presence or an absence of symptoms of focal infection. The age of the patient is also considered a vital factor by many. In reply to a questionnaire prepared by Dr. Elmer Best and covering these points, the following replies were received from Doctors Grove, Howe and Ivy.

Dr. Carl J. Grove: I would not extract any nonvital noninfected teeth either in the presence of or in the absence of symptoms of focal infection.

Dr. Percy R. Howe: I should leave any number of pulpless noninfected teeth in any one mouth. I do not see how noninfected teeth can have anything to do with focal infection, nor do I see how age could make any difference. Should any pulpless teeth become infected, then I should cure the trouble or remove the teeth.

Dr. Robert H. Ivy: I would leave all nonvital noninfected teeth. In the absence of symptoms of focal infection, such teeth could not be responsible for symptoms of focal infection. I would leave them regardless of the age of the patient.

There is practically unanimous opinion today throughout both the medical and dental professions that focal infection is a causative factor in systemic disease and that the teeth and surrounding tissues frequently harbor such foci. The time has long passed for discussion as to whether or not foci of infection about the teeth result in systemic lesions. There is no doubt about that. The practical problems confronting the practitioners are: First: Is the tooth vital? Second: Is the tooth infected? The first question is much easier to answer than the second. Dr. Theodore Blum frankly says: "I must admit that I do not know how one can determine, in vivo, whether a nonvital tooth is infected or not. It is my belief that, from a radiogram alone, it is impossible to determine the presence of infection." Dr. M. B. Guthrie, Lexington, Ky., upon the other hand, says: "The radiographic shadows should be the determining factor. Without evidence of destructive action in the apical region, no extration should be done, whether or not symptoms of toxic absorption are present. The age of the patient should not influence the decision. Extraction of all nonvital teeth should not be practiced. A tooth that is subjected to traumatic occlusion, or one that has undergone a root-canal operation, or even extensive operative work on the crown will, in the majority of cases, show radiographically an increased width of pericemental line. As long as the line is even and unbroken, disease is not indicated." The radiograph, while a valuable aid in diagnosis, should of course always be considered along with the clinical history of the case and a careful examination of the patient.—*Oral Health,* June, 1928.

Vincent's Disease: Conditions that predispose to acquisition of this disease are neglect of the mouth, caries, inflammation of the gums and syphilis. Cigaret smoking has been named as a predisposing cause of the disease. (*J. A. M. A.*, July 28, 1928.) Systemic conditions attributed to the presence of Vincent's organism are anemia, digestive disturbance, serious or even fatal streptococcic infection, noma, gangrenous stomatitis, so-called hospital gangrene and gangrene in various parts of the body. Vincent organisms have been found in healthy mouths, but Bloodgood states that he has never found them in an edentulous mouth, and he therefore concludes that they grow

in the crevices between the teeth. Great care against spreading the infection or contracting it should be taken by dentist and assistant. Preventive measures include frequent cleaning of the teeth by a dentist, filling of carious teeth, extraction of those hopelessly decayed and active treatment for pyorrhea. Toothbrushes should be renewed frequently. Infected tonsils should be removed. Bloodgood recommends the use of a thick paste of sodium perborate, to be retained in the mouth for four or five minutes while an oxidizing froth develops, as curative in 95 per cent of cases. The arsphenamins used locally and intravenously in obstinate cases are found efficacious, one injection usually being sufficient. As a local treatment, arsphenamin may be used in 10 per cent solution in glycerine after the region has been cleansed with hydrogen peroxid. Methylthionin chlorid applied full strength has proved rapidly curative. It is urged that the physician as well as the dentist constantly bear in mind the frequency with which this germ is found to be the cause of tonsil and mouth affections.

Rectal Ether-Oil Drop Anesthesia: Matti *(Zentralbl. f. Chir.)* favors the use of oil-ether rectal anesthesia, using the drop method of administration which permits of controlling the dosage more accurately than with the single massive dose of an oil-ether enema. The average amount required was 4.6 c. c. of ether per kilogram of body weight. The method is advantageous in operations on harelip and cleft palate, and in other operations for which inhalation anesthesia is not suited.—*J. A. M. A.,* July 14, 1928.

Agranulocytic Angina: Dwyer and Helwig (*Am. J. Dis. Child.,* June, 1928) report a case of agranulocytic angina, a condition so designated by Schultz in 1922, and affecting chiefly women of middle age and usually terminating fatally. The authors say: "The onset is sudden, with fever and sore throat; in several instances, it followed closely the extraction of teeth. The characteristic lesions are rapidly spreading ulcers invariably present on the tonsils and pharynx, often on the gums, buccal walls and tongue and about the genitals. There is usually little if any enlargement of the regional lymph nodes, and in about one-half of the cases icterus is present. The blood shows a relative lymphocytosis with a disappearance of all or almost all of the leukocytes of the granular or myelogenous series. Smears made from the lesions in the majority of cases show Vincent's spirilla and fusiform bacilli, although a variety of organisms, such as hemolytic streptococci, staphylococci, colon bacilli and Bacillus phocyaneous have been isolated." The authors report a case in a boy, aged 6 years, who, while under observation for anemia with enlargement of the salivary glands and spleen, developed Vincent's angina, leukopenia and loss of polymorphonuclear cells in the blood. The patient lived two months after the diagnosis was made and apparently was improving, being able to leave his bed and walk about the wards, until the extraction of a tooth precipitated a return of all symptoms. He lived twelve days after this recurrence. Tissue changes were essentially those of septicemia, with little reaction of the defensive forces, owing to the absence of the granulocytes.

Oral Focal Infection and Its Relation to Systemic Disease: Practically all teeth that act as foci of infection have been made pulpless by decay or because of it. Though some pulps of teeth have been devitalized in order to stand the utilation necessary for being used as abutments for bridges, yet, in the newer types of bridgework that may be used today, I do not believe that one is ever justified in devitalizing a tooth for that purpose alone. By the careful education of the public to the importance of visiting a conscientious dentist every six months or oftener, and by great care on the part of the dentist to properly restore the part of the tooth lost by caries before that decay has reached the pulp, there should be very few dental pulps lost in future and hence no focal infection from them. The same early and regular attention to the prevention of pyorrhea will eradicate that source. I believe the time has arrived when a man's success as a family dentist should be measured by the number of patients that he is able to pilot from early childhood to adult life with a full quota of teeth in normal occlusion, with vital pulps and healthy investing membranes. That is the ideal solution of the oral focal infection problem. But, in a few cases where the patient has been unwise enough to neglect a tooth until the pulp is exposed, then, under certain con-

ditions, I believe it is still wise occasionally, where the tooth has strategic value, to devitalize and remove the pulp. But the most obvious and important conclusion, from the research work thus far accomplished, is that root canal operations should be done with much more care and thoroughness than has ever been the case with a large number of practitioners.—Emery Jones, in *Oral Health,* June, 1928.

Skull of a Mongolian Imbecile: In the May and June (1927) numbers of this journal (*Edinburgh M. J.*) an interesting and unusual study of measurements and abnormalities of the mongolian skull will be found. The author (David M. Greig) has not been able to find any previous reference to the macerated skull with the exception of a description of one case by Dr. John Fraser. Incidentally, Greig believes that the "Mongol" should not be classed with idiots as the mental ability is much higher. Three skulls are described, with drawings and numerous photographs, the May number of the journal containing twenty-five in all. The different aspects of the skull, the interior of the cranium, the jaws, teeth and vertebral articulation are described in detail. As is well known, these persons seldom reach adult life, and none of the skulls studied by Greig was from an adult. He includes the measurements of Fraser's case, which was, however, that of a person dying at 40 years of age. Interesting comparisons of the specimens are made by showing superimposed skull tracings. In the June number, the writer discusses the marks of difference between the skull of a mongolian and that of the microcephalic imbecile, the former having a general smallness but a proportionately large cranial capacity, nearly twice that of the microcephalic imbecile. The writer concludes that mongolism is a defect of growth in fetal life, rather than in embryonic development. He finds that the characteristics of the skull can be summarized as the ready bony ankylosis of the synchondroses at the base occurring at the time of maximum brain growth; shortness of the head and relative increase in the interzygomatic breadth; the spongy layer in the cranial bones is poorly developed; the teeth, especially the upper and anterior ones, are irregular; the palate is flat, broad, but infantile; the maxillae and facial bones have not grown completely; the lower jaw is modified in shape; and an infantile condition of the bones of the skull and face is shown by the many anatomic peculiarities. —*Am. J. Dis. Child.*

MISCELLANY

BOOK REVIEWS

Dental Health in the Prevention of Disease. Education, Health, Protection. Illustrated. 95 pages. Price, $2.50. Published by the Educational Dental Health Co., London, Ky.

The contributors to this volume include such names as C. Tyree, Harold J. Leonard, Judson Daland and A. Moorman Hardaway. Blanche D. Small also contributes some stories, intended for children.

Many of the illustrations in the book are colored, and certain of them are outstanding. They will prove very attractive and instructive to the laity, for whom the book was written. Mention of the laity brings up a consideration which at once strikes the reader. One of the chapters in particular is too technical for lay readers. No matter how excellent a contribution may be, it does not register its full benefit when the ideas are clothed in language that is not readily understood by the group for whom it was written. The authors have realized this and have made a laudable effort to remedy it by the publication of a statement that most of the technical terms are defined in a dictionary at the back of the book. This is a plain recognition of the fact that without this dictionary the article could not be intelligently followed by lay readers, and yet a little further reflection will convince anyone that no lay reader is going to wade through any article by the labored method of looking up the meaning of words in order to gain an intelligent conception of their import.

But aside from this there is enough of good in the book to commend it to readers, and there is no praise too great for the mechanical makeup. The paper is excellent, the cuts good and the type clear and satisfactory. The book is capable of doing great good.

Dentition as a Measure of Maturity. By Psyche Cattell, Research Associate, Psycho-Educational Clinic, Harvard University. Studies in Educational Psychology and Educational Measurement. 91 pages, 36 illustrations. Price, $1.00. Published by Harvard University Press, Cambridge, Mass.

This is one of the Harvard Monographs in Education, and is worthy of much study. A vast amount of work has been put into its preparation, and this work has apparently been done with much care.

There is one suggestion to be made to the author. It is time the word "canine" as applied to human teeth should be discarded from our literature. Argument enough has been made to keep this term out, but apparently more is needed. We would suggest that if another edition is called for, this word be changed to "cuspid," which is the proper term. The monograph is worth the price charged for it, and every dentist who is at all interested in the subject should possess a copy.

The American Textbook of Prosthetic Dentistry. In contributions by eminent authorities. Edited by Charles R. Turner, D.D.S., M.D., Professor of Prosthetic Dentistry and Dean of the School of Dentistry, University of Pennsylvania, Philadelphia, and L. Pierce Anthony, D.D.S., F.A.C.D., Associate Editor of *The Dental Cosmos.* Fifth edition, thoroughly revised. Illustrated with 881 engravings and 3 colored plates. 722 pages. Price, $10.00 net. Published by Lea & Febiger, Philadelphia.

It has been fifteen years since the previous edition of this splendid work was issued, and this has given ample time for a pronounced revision. New chapters on partial plate dentures and on cast metal dentures have been added, and the entire work has been brought to date. The rather difficult problem of articulation has been met by considering and illustrating most of the standard articulators on the market, which leaves the reader free to make his own selection. As nearly as possible, principles have been considered, which we believe to be the correct method of treating a subject of this character.

A chapter is given to "Artificial Crowns" and one to "Bridgework." There is also a comprehensive chapter on "Cleft Palate Prosthesis."

All in all, this edition maintains the high mark this book has always set, and the editors and publishers are to be congratulated on the result.

CORRESPONDENCE

To the Editor:

I have been greatly interested in the letter written by Dr. W. H. Shipway of Bristol, England, in the June, 1928, issue of your esteemed journal. I quite appreciate Dr. Shipway's point of view and welcome his criticism of the dental conditions in India. But he is very far from the truth when he says "Indians expect too much of any government and rely too much on the government instead of on themselves." Just to show that Indians have been helping themselves, I will point to one or two facts. The first dental college in India was founded in Calcutta in the year 1920, entirely by private initiative and finances. Since that time, that college has been meeting the needs of India in the way of qualified dental practitioners. The college is now in a flourishing condition. There is a free dental clinic attached to the college, and we find in its annual report for 1927-1928 that, during the year, 2,987 poor patients received dental treatment, who would never have received any dental relief were it not for this college clinic. This certainly does not show that all Indians are apathetic and are unable or unwilling to help themselves.

In a professional periodical, it is unseemly to go into political controversies. But Dr. Shipway has seen fit to remark that all progress in India has been made "in spite of Indian opposition and not with their help." I would not go into vague generalizations, but would only submit that as far as dental progress in India is concerned, the British-Indian government has done absolutely nothing up-to-date, not even the elementary duty of protecting its own people from quack and unqualified dentists. Indians have organized the first dental school in the land and established free dental clinics. The British-Indian government can claim no part in these achievements. Were it possible, they would have seen to a Dental Registration Act also.

All these do not prove that all progress in India is opposed by the Indians.

Yours faithfully,

R. AHMED.

Calcutta, India.

To the Editor:

It was with considerable interest that I read the article on "Women in Dentistry," in the September number of THE JOURNAL. While it covers the period from 1855 to 1880, it also refers to 1821, the year in which "we probably have the earliest vision of the lady dentist."

However, there is a record of a woman dentist prior to that. Mrs. Dawson, the widow of John Bryckett, a "toothe drawer," who evidently married after Bryckett's death, continued his practice, but was forbidden to do so.

"London, England.—Into the Company of Barber Surgeons, dentists were occasionally admitted, the first recorded admission being under date of Sept. 10, 1551, when John Bryckett, 'toothe drawer', was admitted 'for a brother into this house.' On Aug. 26, 1557, it is recorded in the minutes of the Court, that Mrs. Dawson, the 'widow of one Bryckett, a toothe drawer, shall pay no quartrydge to the hawle nor hange oute any signs or clothe with teethe as she heartofore hath done'."

As far as I know there is no earlier mention of a woman as a dentist.

LOUIS OTTOFY.

Chicago, Ill.

NEWS

Attendance at Annual Session: The attendance at the Seventieth Annual Session of the American Dental Association, held in Minneapolis, Minn., August 20-24, is officially reported as well over 8,300, the largest attendance yet reported for the yearly meeting.

Dental Surgeons of Army Hold Banquet: Members of the American Association of Military Dental Surgeons held their annual banquet at the Leamington Hotel, Minneapolis, August 22. Lieut.-Col. C. T. Messner of the United States Public Health Service presided as toastmaster. Talks were given by Lieut.-Com. William Cogan, dean of Georgetown University; Col. William C. Fisher of New York City; Homer C. Brown of Columbus, Ohio, and Mark F. Finley of Washington, D. C.

New School for Dental Hygienists: A school for dental hygienists was recently established at Atlanta, Ga. Robin Adair of Atlanta is the director. The first course will cover a period of nine months. Clinic work will be done in private dental offices until the growth of the school justifies the establishment of a special infirmary.

DEATHS

Baer, Harry K., Lancaster, Pa.; University of Pennsylvania School of Dentistry, 1892; died, August 18; aged 57.

Hicks, Henry F., Joliet, Ill.; died, August 16; aged 69. Dr. Hicks practiced in Joliet for half a century, retiring two and a half years ago.

Long, J. H., Gary, Ind.; Northwestern University Dental School, 1907; died, August 7; aged 45.

McCormack, R. F., Atlanta, Ga.; Atlanta Dental College, 1911; died, August 4; aged 54. Dr. McCormack was a veteran of the Spanish-American War.

Miller, Frank B., Pearisburg, Va.; Virginia College of Medicine, Dental Department, 1905; died, August 3.

Wagner, J. E., Mineral City, Ohio; Ohio Medical University, College of Dentistry, 1902; died, August 13; aged 54.

ANNOUNCEMENTS

CALENDAR OF MEETINGS

NATIONAL SOCIETIES

American Dental Association, Washington, D. C.

STATE SOCIETIES

District of Columbia, at George Washington University, Washington, D. C., second and fourth Tuesdays in each month from October to June inclusive.

September (1928)
Maryland, at Annapolis (10-11).
December (1928)
Ohio, at Toledo (4-6).
May (1929)
Iowa, at Cedar Rapids (7-9).
West Virginia, at White Sulphur Springs (20-22).

Chicago Dental Society Midwinter Clinic, Jan. 14-16, 1929.

First District Dental Society of the State of New York, Dec. 3-6, 1928.

New York Society of Orthodontists, at Boston, Mass., Oct. 24, 1928.

Tri-State Clinic, Memphis, Tenn., Oct. 22-23, 1928.

MEETINGS OF STATE BOARDS OF DENTAL EXAMINERS

Indiana, at Indianapolis, Nov. 12, 1928. Secretary-Treasurer, J. M. Hale, Mt. Vernon.

Massachusetts, at Boston, Oct. 9-11, 1928. Secretary, W. Henry Grant.

Michigan, at Ann Arbor, Nov. 19-24, 1928. Secretary, J. W. Lyons, 617-621 Dwight Bldg., Jackson.

New Jersey, at Trenton, Dec. 3-8, 1928. Secretary, John C. Forsyth, 148 West State St., Trenton.

Pennsylvania, at Philadelphia and Pittsburgh, Dec. 5-7, 1928. Secretary, Alexander D. Reynolds, 4630 Chester Ave., Philadelphia.

INDIANA STATE BOARD OF DENTAL EXAMINERS

The Indiana Board of Dental Examiners will meet at 8 a. m., November 12, at the State House, Indianapolis, in the House of Representatives Room, for the purpose of examining all applicants with proper credentials. All applications should be in the hands of the secretary one week before the meeting of the board.

For applications, clinical requirements and other information, address

J. M. Hale, *Sec'y-Treas.*,
Mt. Vernon.

Note.—Announcements must be received by the fifth day of the month in order to be published in the forthcoming issue of The Journal.

MASSACHUSETTS BOARD OF DENTAL EXAMINERS

The Massachusetts Board of Dental Examiners will hold an examination for registration for both dentists and oral hygienists, in the City of Boston, October 9-11. Full information, application blanks, etc., may be secured at the office of the secretary, Room 146, State House, Boston. All applications must be filed at the office of the secretary at least ten days before the date set for the examination.

W. Henry Grant, *Secretary.*

FIRST DISTRICT DENTAL SOCIETY OF THE STATE OF NEW YORK

The First District Dental Society will hold its Fourth December Meeting for Better Dentistry at the Hotel Pennsylvania, New York City, December 3-6. This year, the Main Ball Room and the South East Ball Room will be used in addition to the Roof Garden. This will be a subscription meeting as were the former ones, $5 admitting to all lectures and clinics. As in former years, subscribers must register for many of the clinics although there will be a large number of the so-called open clinics. Special features will be an oral hygiene luncheon, on Wednesday, when Percy R. Howe, President of the American Dental Association, will be the guest of honor. Other national officers to be presented will be Harry B. Pinney, Secretary, and C. N. Johnson, Editor. On Wednesday afternoon, there will be a session of four section meetings under the direction of the section chairmen, devoted to papers on oral surgery, preventive dentistry, pathodontia and prosthodontia. On Thursday, at 2 p. m., topic discussions, which have proved to be one of the most popular features, will be held. On Thursday evening, the Grand Ball Room and adjacent rooms and foyer will be the scene of the general clinics.

Manufacturers' exhibits will be shown during the meeting.

Address all inquiries to E. M. Davies, Executive Secretary, Academy of Medicine, Fifth Ave. and 103d St., New York City.

John T. Hanks, *Secretary.*

NEW YORK SOCIETY OF ORTHODONTISTS

(Change in place of Fall Meeting.)

The Fall Meeting of the New York Society of Orthodontists will be held in Boston,

Mass., the morning and afternoon of Wednesday, October 24. Both sessions will be held in the University Club, Copley Square. An unusually attractive program has been arranged by the members of the society residing in and around Boston. This is the first time that the meetings of the society have been held elsewhere than New York City, and the Boston men have prepared for the meeting with enthusiasm. All ethical members of the medical and dental professions are cordially invited to be present.

The University Club is one minute walk from the Back Bay Station.

WILLIAM C. FISHER, *Secretary*,
501 Fifth Ave., New York City.

TRI-STATE CLINIC

The Tri-State Clinic meets in Memphis, Tenn., October 22-23. An intensive program of preventive dentistry has been arranged for two days and one evening. Thaddeus P. Hyatt, New York City; Russell W. Bunting, Ann Arbor, Mich.; Sherman L. Davis, Indianapolis, Ind.; Arthur H. Merritt, New York City, and Boyd S. Gardner, Rochester, Minn., will lecture and present clinics. Attendance is limited to 250, and a fee of $10 will be charged to defray actual expenses. Reservations, accompanied by check, will be made in the order of their receipt.

TERRELL OGDEN, *Secretary*,
628 Medical Arts Bldg.,
Memphis, Tenn.

IOWA STATE DENTAL SOCIETY

The next annual meeting of the Iowa State Dental Society will be held in Cedar Rapids, May 7-9, 1929.

JOHN SCHOLTEN, *Secretary*,
306 American Trust Bldg.,
Cedar Rapids.

MICHIGAN STATE BOARD OF DENTISTRY

The Michigan State Board of Dentistry will hold its next examination for registration of both dentists and oral hygienists at the Dental College building, University of Michigan, Ann Arbor, November 19-24. The examination begins at 8 p. m. All applications must be on file in the secretary's office thirty days before the date of the examination. For information and blanks, address

J. W. LYONS, *Secretary*,
617-621 Dwight Bldg.,
Jackson.

COMMONWEALTH OF PENNSYLVANIA STATE DENTAL COUNCIL AND EXAMINING BOARD

The next regular examination of the Pennsylvania State Dental Council and Examining Board will be held in the Civil Service Room, City Hall, Philadelphia, and the University of Pittsburgh, Pittsburgh, December 5-7. The practical work will be held Saturday, December 8, at Temple University, 18th and Buttonwood streets. An examination for hygienists will be held at the same times and places. Application papers may be secured from the Department of Public Instruction, Harrisburg. For further information, address

ALEXANDER H. REYNOLDS, *Secretary*,
4630 Chester Ave.,
Philadelphia.

EXAMINATION FOR APPOINTMENT TO DENTAL CORPS OF U. S. NAVY

A competitive examination for appointment to the Dental Corps of the United States Navy will begin December 3, at the U. S. Naval Medical School, Washington, D. C. Candidates must be citizens of the United States, between 21 and 32 years of age at the time of appointment, and graduates of recognized dental schools. The examination will be both theoretical and clinical and the usual duration is about seven days. Application forms and a circular of information may be obtained from the Chief of the Bureau of Medicine and Surgery, Navy Department, Washington, D. C. No allowance is made for the expense of applicants appearing for examination.

E. R. STITT, *Surgeon-General*,
U. S. Navy

SOME RECENT BOOKS
Available for Circulation from the
LIBRARY BUREAU
AMERICAN DENTAL ASSOCIATION*

Appleton, J. L. T., Jr.	Bacterial infection with special reference to dental practice. Philadelphia, Lea & Febiger, 1925.
Appleton, J. L. T., Jr., & Bryant, C. K.	Laboratory guide in bacteriology. Philadelphia, Lea & Febiger, 1928.
Barail, L. C.	High-frequency in dentistry. Paris, France, La Verrerie Scientifique, 1927. (Pamphlet.)
Berger, Adolph	Principles and technic of oral surgery. Brooklyn, Dental Items of Interest Pub. Co., 1927.
Broderick, R. A.	Dental bacteriology. Outlines of dental science. Vol. 2. Edinburgh, Livingstone, 1926.
Broomell, I. N., & Fischelis, Philipp	Anatomy and histology of the mouth and teeth. Philadelphia, Blakiston, 1925.
Brown, A. J.	Dental metallurgy. Outlines of dental science. Vol. 11. New York, Wood, 1928.
Brown, W. L.	Endocrines in general medicine. St. Louis, Mosby, 1927.
Buckley, J. P.	Modern dental materia medica, pharmacology and therapeutics. Philadelphia, Blakiston, 1926.
Bulleid, Arthur	Textbook of bacteriology for dental students. St. Louis, Mosby, 1927.
Burchard, H. H., & Inglis, O. E.	Textbook of dental pathology and therapeutics for students and practitioners. Philadelphia, Lea & Febiger, 1926.
Buxton, J. L. D.	Dental pathology. Outlines of dental science. Vol. 7. New York, Wood, 1927.
Buxton, J. L. D.	Dental surgery. Outlines of dental science. Vol. 8. New York, Wood, 1927.
Cattell, Psyche	Dentition as a measure of maturity. Cambridge, Harvard University Press, 1928.
Clapp, G. W.	Life and work of James Leon Williams. New York, Dental Digest, 1925.
Clark, C. A.	Dental radiography. Outlines of dental science. Vol. 5. New York, Wood, 1926.
Colyer, Stanley	Chronic infection of the jaws: a short radiological and clinical study. New York, Macmillan, 1926.
Dental Board of the United Kingdom	Four lectures on "general anaesthesia." London, Dental Board of the United Kingdom, 1926.
Dental Board of the United Kingdom	Three lectures on "dental alloys." Delivered under the auspices of the Dental Board of the United Kingdom. London, Dental Board of the United Kingdom, 1927.
Endleman, Julio	Special dental pathology: a treatise for students and practitioners. St. Louis, Mosby, 1927.
Federspiel, M. N.	Harelip and cleft palate. St. Louis, Mosby, 1927.
Feldman, M. H.	Manual of exodontia. Philadelphia, Lea & Febiger, 1926.
	First International Orthodontic Congress: held at New York City, August 16-20, 1926. St. Louis, Mosby, 1927.
Fones, A. C.	Mouth hygiene; a textbook for dental hygienists. Philadelphia, Lea & Febiger, 1927.

*Books may be borrowed by members of the Association for a period of one week after date of receipt; and if not reserved for some one else, the period will be extended on request. A deposit of $2.00 for each volume asked for should accompany all requests for books. This will be refunded on return of books.

Fones, A. C.	Preventive dentistry. Philadelphia, Lea & Febiger, 1925.
Foote, J. S.	Bone as a measure of development: When and how we acquired our teeth. Chicago, American Dental Association, 1928.
Gies, W. J.	Dental education in the United States and Canada. New York, Carnegie Foundation, 1926.
Goepp, R. M.	Dental state board questions and answers. Philadelphia, Saunders, 1928.
Goslee, H. J.	Principles and practice of crown and bridgework. Brooklyn, Dental Items of Interest Pub. Co., 1926.
Greenfield, A. L.	Interpretation of dental radiograms. Rochester, N. Y., Ritter Dental Mfg. Co., 1926.
Guerini, Vincenzo	Life and works of Guiseppangelo Fonzi. Philadelphia, Lea & Febiger, 1925.
Gwinn, C. D.	Textbook of exodontia. Philadelphia, Lea & Febiger, 1927.
Haden, R. L.	Dental infection and systemic disease. Philadelphia, Lea & Febiger, 1928.
Hanau, R. L.	Dental engineering. Buffalo, N. Y., Author, 1926.
Hanau, R. L.	Hanau intraoral method vs. Gysi extraoral method. Buffalo, N. Y., Author, 1927.
Hartman, L. L.	Teeth and the mouth. New York, Appleton, 1927.
Head, Joseph	Everyday mouth hygiene. Philadelphia, Saunders, 1925.
Headridge, David, & Gibson, S. K.	Dental anatomy, human and comparative. Outlines of dental science. Vol. 6. New York, Wood, 1928.
Herbst, Emil, & Apffelstaedt, Max	Atlas und grundriss der missbildungen der kiefer und zähne. München, J. F. Lehmanns, 1928.
Hertzler, E.	Technic of local anesthesia. St. Louis, Mosby, 1925.
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